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**Interruptions to nurses' work in dynamic healthcare settings  
part of a wider problem of competing demands**

Walne, Simon

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King's College London

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# **Interruptions to nurses' work in dynamic healthcare settings: part of a wider problem of competing demands**

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**Simon Walne BSc, MSc**

**A thesis submitted as part fulfilment of the requirements of  
King's College London for the degree of  
Doctor of Philosophy in Healthcare Studies**

**Supervised by Prof. Jill Maben, Dr. Janet Anderson,  
and Prof. Anne Marie Rafferty**

# Abstract

While much attention has been devoted to the topic of interruption over recent years, few studies have explored in detail the context of these events. The study aims to understand the nature of interruptions, and the role of clinical context in shaping nurses' handling of these.

The research was conducted in three purposively selected settings: an Accident and Emergency department, a surgical ward, and a chemotherapy centre, in one NHS trust. Phase One data collection involved, for each setting: 6 static observation sessions (lasting 48 hours in total), 8 nurse shadowing sessions (132 hours in total), and 4 semi-structured interviews. Phase Two data comprised, for each setting, structured observations of 8 nurses (60 hours in total), interviews with 4 nurses, and Hierarchical Task Analysis of two specific nursing tasks (surgical medication round and ambulance triage task).

Phase One highlighted the complexity and dynamism of the clinical environment. Nurses intentionally interrupted tasks, in a strategic manner, to support the handling of competing demands. Interruptions allowed nurses to respond rapidly and flexibly to events, and to keep track of their workload. These findings challenge the 'traditional account' of interruptions, identified in the literature review, which implies that interruptions are externally imposed and undesirable events. A new conceptual framework was therefore developed, based on a further literature review, and this was used to guide Phase Two.

Phase Two investigated nurses' use of the healthcare system, and other strategic behaviours such as interruption, in handling competing demands during

specific nursing tasks. Key aspects of the healthcare system that supported nurses' task management included specific tools (e.g. drugs charts), technologies (e.g. A&E computer system), and teamworking, while adaptive strategies that proved useful included sensemaking and monitoring.

In conclusion, the study reveals interruptions to be part of a wider problem of competing demands. It highlights the need for more contextualised research, which considers how interruptions, combined with other strategic behaviours, might support the management of healthcare complexity.

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# List of Abbreviations

A&E	Accident and Emergency
FA	Framework Analysis
FAM	Framework Analysis Method
HCA	Healthcare Assistant
HDU	High Dependency Unit
HTA	Hierarchical Task Analysis
HTT	Hierarchical Task Timeline
IoM	Institute of Medicine
ICU	Intensive Care Unit
NICU	Neonatal Intensive Care Unit

# Chapter 1 Introduction

The healthcare environment is an extremely complex one, in which demands are unpredictable, and resources are often stretched to the limit (Ebright et al., 2003; Potter et al., 2005). Healthcare professionals must manage these demands by interacting with other people and technologies to co-ordinate patient care (Carayon, 2006; Roth et al., 2004). Their cognitive resources are often strained by the need to constantly shift attention, and to remember multiple tasks (e.g. Ebright et al., 2003; Potter et al., 2005).

Amid this complexity there has been growing concern for patient safety. Studies regarding the incidence of medical errors have suggested that this concern is warranted; some 850,000 incidents harm patients in National Health Service (NHS) hospitals in the UK every year (Department of Health, 2000). Other research suggests that between 3% and 17% of patients treated in acute care hospitals experience one or more adverse events (Baker et al., 2004).

The US Institute of Medicine's (IoM) influential report *To Err is Human* (Kohn et al., 2000) highlighted a number of potential contributors to medical errors – one of which was interruptions. The authors noted that little was known about these phenomena, and they called for more research to understand the nature and the effects of these events.

A common concern regarding the effects of interruptions concerns their potential to result in omissions – one of the most significant hazards in safety-critical industries (Reason, 1990; Latorella, 1996). Interruptions can disrupt established routines leading to confusion regarding which activities have already been

completed, and which have not (Tucker and Spear, 2006; Trbovich et al., 2010). This could result in an individual missing an important task step, while clinicians might forget altogether to resume interrupted tasks (Tucker and Spear, 2006; Grundgeiger et al., 2010; Gillie and Broadbent, 1989).

Other deleterious effects of interruptions might relate to more general challenges vis-à-vis task switching. Such challenges include the need to prioritise tasks, to allocate time and attention appropriately (i.e. to ensure that important tasks are not neglected because an individual is engrossed in a particular activity), and to try to maintain productivity (Loukopoulos et al., 2009; Wickens et al., 2012b; Monsell, 2003). Interruptions might impair productivity because they require individuals to recall contextual information regarding interrupted tasks, while they might also necessitate the recovery of mental schema i.e. the rules and concepts that govern task performance (Allport et al., 1994; Monsell, 2003).

While all of the above might have implications for the quality and safety of patient care, interruptions might also have deleterious effects for the wellbeing of health professionals (Cooper et al., 1989; Klemets and Evjemo, 2014). Research suggests that dealing with interruptions can be stressful and mentally demanding, as individuals must juggle competing task requirements (Klemets and Evjemo, 2014; Zijlstra et al., 1999).

Although extant research has focused on the potential negative effects of interruptions, it is also possible that interruptions might support healthcare work in certain respects (Savoldelli et al., 2010; Campbell et al., 2012). Interruptions might involve communications that support task performance, for instance, while they might also allow individuals to respond to urgent requests (Grundgeiger et

al., 2009; Campbell et al., 2012). If interruptions have benefits for clinicians, as well as costs, this raises questions regarding which of these take precedence (that is, whether the costs outweigh the benefits). It also points to the potential need for clinicians to ‘trade-off’ potential positive and negative effects (Rivera, 2014).

The question of whether interruptions contribute more to positive, rather than negative, outcomes is particularly pertinent since the trends that may be responsible for their prevalence may be intensifying. Technology plays an ever larger role in healthcare, and research suggests that clinical information systems, to give one example, have contributed to greater work fragmentation (Holden, 2011; Ash et al., 2004). The ubiquity of personal digital devices, such as mobile phones and laptops, also place additional demands on attention (Spink et al., 2008; Bardhi et al., 2010).

Some 15 years after the IoM report, scores of studies regarding healthcare interruptions have now been conducted, in a variety of clinical settings (Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013a). These are reviewed in Chapter 2.

## Chapter 2 Literature Review

The main aims of the literature review were to establish what is known about interruptions in healthcare, to determine the strengths and weaknesses of extant research, and to identify gaps in the literature that might be addressed by the current doctoral study. More specific objectives were to examine the main concepts that have been considered in relation to interruptions, and to appraise the approaches that have been taken (e.g. the research design, methodology, and specific methods used) in doing this.

Given these aims and objectives, it was considered that a scoping review would be most appropriate. Scoping reviews aim to address 'what is known about [topic X]' questions, and to represent the breadth of extant research – in contrast to systematic reviews, which address narrow research questions (e.g. is intervention X more effective than intervention Y?), and which frequently exclude studies (e.g. on the grounds of quality criteria, or relevance regarding a narrow topic; Arksey and O'Malley, 2005; Davis et al., 2009; Norman and Griffiths, 2014). Both types of review are methodical in their using standard techniques to identify and evaluate relevant studies, however, while systematic reviews usually quantify the 'strength of the evidence' on a topic, scoping studies rely on qualitative assessment (Davis et al., 2009). While a scoping review might be appropriate in a research area that is well understood, and where suitable 'conceptual tools' have been developed, it is not clear that this is true of the healthcare interruptions literature (Grundgeiger and Sanderson, 2009;

Hopkinson and Jennings, 2013a). It was decided therefore that a scoping review would best help to achieve the above-stated aims and objectives.<sup>1</sup>

## 2.1 LITERATURE SEARCH

Interruptions were defined, for the purpose of the review, as disruptions to the workflow, or discontinuity in a clinician's attention. An initial literature search was performed to cover the period 1980 through July 2015. Details of the literature search strategy, including keywords, databases, and inclusion/ exclusion criteria are described in Table 2-1.

*Table 2-1 Details of literature search strategy and inclusion/ exclusion criteria*

Keyword Search Term	Databases	Inclusion Criteria	Exclusion Criteria
(interrupt* AND healthcare*) OR (interrupt* AND nurs*) OR (interrupt* AND physician*)	CINAHL MEDLINE EMBASE PsycInfo	-Interruptions main focus -Peer-reviewed journal articles with abstract -Reports empirical data regarding interruptions, not described previously -Study conducted in 'real-world' clinical setting(s) -Complete studies only	-Interruptions peripheral -Conference proceedings and media reports -Editorials, literature reviews, and multiple presentations of the same data (incl secondary analysis) -Experiments, simulations or other 'artificial studies' -Pilot studies

The search strategy was developed iteratively by exploring the results of a variety of different keyword- and subject-heading searches. Details of different terms and headings examined, and the results obtained from these, can be found in Appendix A.

The inclusion and exclusion criteria reflected a desire to conduct a comprehensive review, covering all healthcare settings. The decision to exclude studies where interruptions were peripheral (that is, they were not a central focus

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<sup>1</sup> The differences between these review types have only recently been highlighted, and many reviews that might be better described as scoping reviews have been labelled 'systematic' (Norman and Griffiths, 2014).

of the research) was based on the observation that these were quite numerous, and added little compared with the more focused investigations. Restricting the study to peer-reviewed articles reduced the amount of repetition in the results without obviously affecting the breadth of study types identified. Finally, experimental and simulation studies were excluded because the researcher was interested in real-world interruptions, and concerned about the ecological validity of research conducted in contrived environments.

The search criteria described in Table 2-1 identified some 5,891 articles. Among these were five recent 'systematic' literature reviews (Grundgeiger and Sanderson, 2009; Biron et al., 2009b; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013a; Raban and Westbrook, 2013). (Based on the distinctions made above, these might be more accurately described as 'scoping' reviews.)

Given the existence of five reviews, it was considered likely that most, if not all, of the relevant literature (as determined by the inclusion/ exclusion criteria) would be covered by these. This would not, of course, negate the need to review these papers first hand, but it might, it was thought, eliminate the need to search through all 5,891 papers to determine their relevance (i.e. since the reference lists of the five reviews could be combined to identify relevant papers).

To establish the comprehensiveness of the five reviews with regard to the current study's inclusion/ exclusion criteria (and hence to determine the need to conduct a whole new search) the search strategies employed by these reviews were examined in detail. Significant similarities were found in the periods of time covered, particular search terms used, and the clinical area of interest, between

the current and existing reviews. However, three of the existing reviews (Grundgeiger and Sanderson, 2009; Biron et al., 2009b; Rivera-Rodriguez and Karsh, 2010) covered only the period up to 2008, and the two remaining studies were restricted to quite narrow topics (Raban and Westbrook, 2013, examined only intervention studies; Hopkinson and Jennings, 2013a, looked only at interruptions to *nurses'* work). This suggested the need to conduct a new search covering the period January 2009 to July 2015 (i.e. since the reviews covering this period were not adequately comprehensive). However, to establish the need for a new search *for the period prior to 2009*, further analysis was required.

Figure 2-1 depicts the analysis that was conducted. A random sample of 20% (n=1178) of the 5,891 retrieved articles (depicted on the left side of the process-flow in Figure 2-1) were compared against the papers cited by the systematic reviews (on the right side of the process-flow), to determine whether relevant articles had been omitted from the reviews.<sup>2</sup> A total of 19 papers met the inclusion/ exclusion criteria, and all except one of these were included by the systematic reviews. Given the efficiencies gained by relying on the extant reviews' search efforts, the decision was made to do this for the period in question (the period prior to 2009).

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<sup>2</sup> The decision to look at 20% of the retrieved articles was based on the view that this would be sufficient to provide a good indication of the comprehensiveness of the five extant literature reviews; the specific percentage figure (20%) was selected arbitrarily. Microsoft Excel 2011 was used to randomly select and organise the retrieved articles, after they were downloaded from the specified databases.



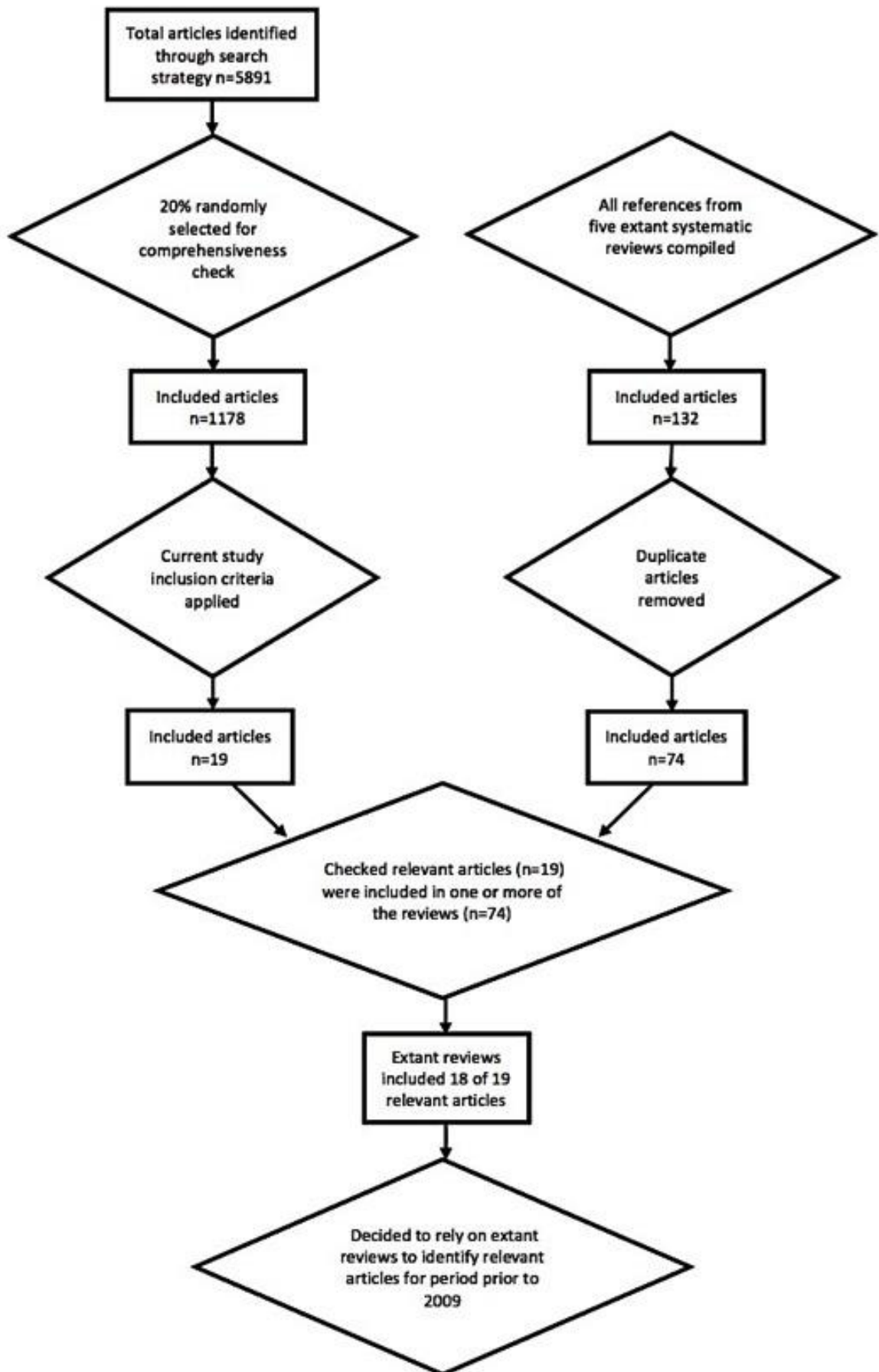


Figure 2-1 Check for comprehensiveness of systematic reviews (prior to 2009)

### **2.1.1 Search Results**

Figure 2-2 depicts the results of the literature search. The process-flow on the left side of the figure shows the results regarding studies published *prior to 2009* (which relied on the papers cited by the five systematic reviews), while the process-flow on the right depicts those pertaining to the period from January 2009 onwards.

#### **Studies Published Prior to 2009**

Some 74 unique articles published prior to 2009 were cited by the systematic reviews. Each article was reviewed in full to determine its conformity to the inclusion/ exclusion criteria. A total of 36 articles were retained.

#### **Studies Published From 2009-2015**

The search strategy described in Table 2-1 returned 1542 unique articles (for 2009 through July 2015). The titles and abstracts of these papers were reviewed to determine their accordance with the inclusion/ exclusion criteria. A total of 143 articles were examined in full to further determine their suitability. Some 51 articles met the criteria, and their references were examined, by hand, for omitted articles. Six additional studies were identified through this process. A total of 57 papers published between 2009-2015 were reviewed. Together with the 36 articles identified for the period up to 2008, an overall total of 93 articles were included in the review.<sup>3</sup>

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<sup>3</sup> A number of discussion papers that did not meet the inclusion criteria were read and are cited in the review.

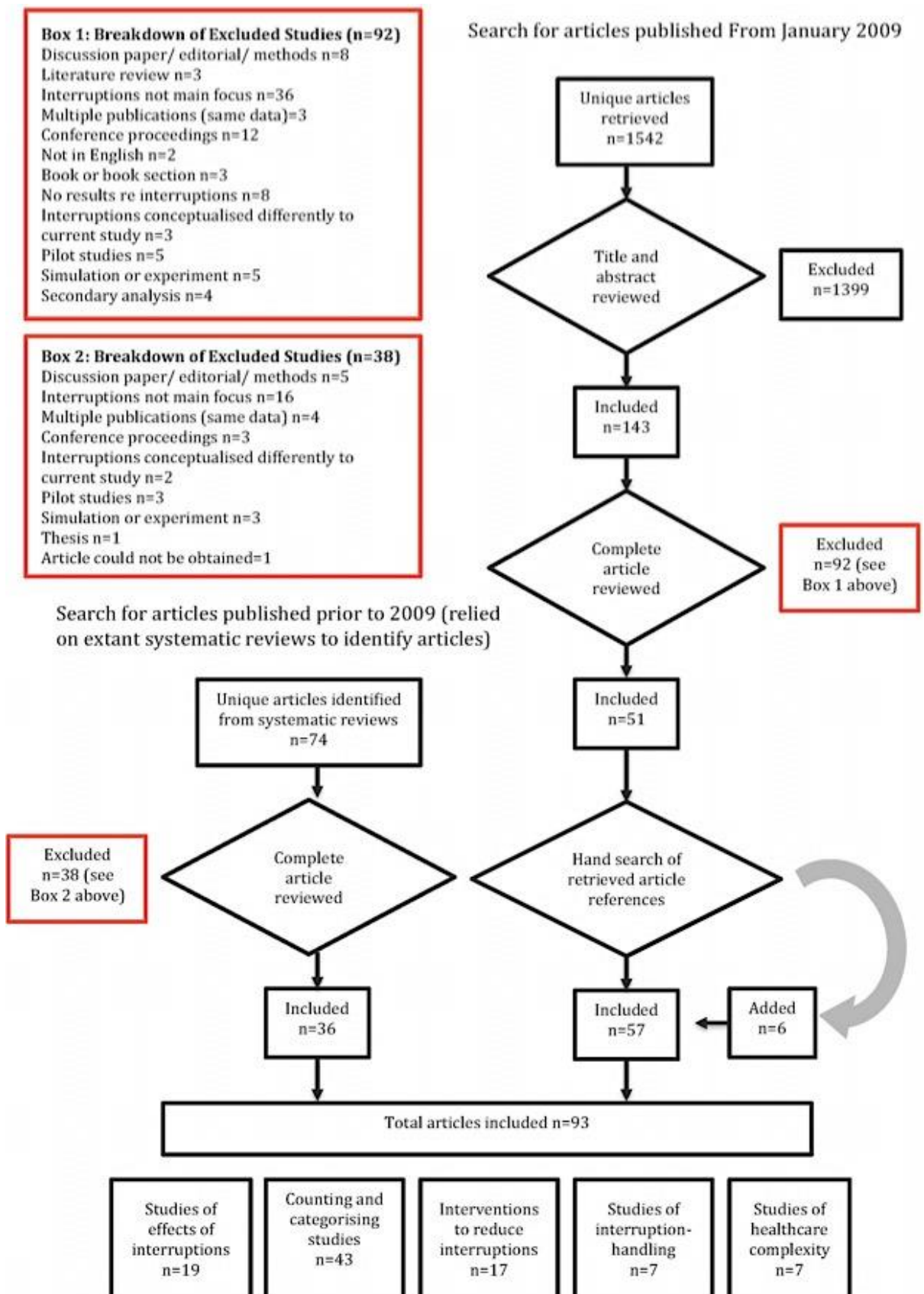


Figure 2-2 Literature search results and exclusions

## 2.2 EXISTING SYSTEMATIC REVIEWS

The five extant systematic reviews, mentioned above, were examined to establish what might be learned for the current study. Table 2-2 describes the focus of each of the reviews, as well as key inclusion and exclusion criteria.

*Table 2-2 Characteristics of systematic reviews of interruptions in healthcare*

	<b>Biron et al., 2009b</b>	<b>Grundgeiger and Sanderson, 2009</b>	<b>Rivera-Rodriguez and Karsh, 2010</b>	<b>Hopkinson and Jennings, 2013a</b>	<b>Raban and Westbrook, 2013</b>
Settings	All healthcare settings where medications given	Critical care and settings where medications given	All healthcare	Acute healthcare settings	Acute healthcare settings
Aims/ research questions	To review evidence on (1) nurse interruption rates, (2) interruption characteristics, (3) contribution of interruptions to drug admin errors	To examine evidence of relationship between interruption and adverse events	To systematically review the literature on interruptions in healthcare to determine state of the science and to identify gaps	To examine empirical evidence from studies of interruptions in acute care nurses' work environments	To review the effectiveness of interventions designed to reduce medication administration interruptions, and medication errors
Period	1980-2008	2002-2008	No start-2008	2001-2011	No start-2012
Criteria	-Nurses' medication interruptions only -English only -Empirical data -Peer-reviewed journal articles only -Only papers that report interruption frequency rates	-Interruptions to any healthcare professional -English only -Empirical data -Included 'in-press' and some conference papers	-Interruptions to any healthcare professional -English only -Empirical data reported -Peer-reviewed journal articles only	-Nurse interruption studies only -English only -Empirical data reported -Peer-reviewed journal articles only	-Studies with aim of reducing interruptions during drug admin -Nurses' drug admin only -Quantitative data reported -Direct observation studies only
Articles Included	23	35	33	31	10

While each review used a slightly different search strategy, and covered a unique set of studies, there was considerable overlap in the literature covered. Study findings can therefore be meaningfully compared. Table 2-3 summarises the main results, and highlights methodological criticisms, as well as suggestions for future research.

*Table 2-3 Findings of five systematic reviews of interruptions in healthcare*

Authors	Main results and conclusions	Methodological evaluation and suggestions for future studies
Biron et al., 2009b	<ul style="list-style-type: none"> <li>*Interruptions occur frequently in healthcare: a 'pooled estimate', based on 14 studies, indicated interruption rate of 6.7 per hour</li> <li>*However, not enough attention paid to studying effects of interruptions on drug errors.</li> <li>*Just one of the reviewed studies found a significant association between interruptions and medication errors</li> <li>*Interruptions mostly initiated by nurses through face-to-face interactions.</li> <li>A lower proportion of interruptions resulted from work system failures, such as missing medication or supplies</li> <li>*Most interruptions of short duration</li> <li>*Efforts should be made to reduce interruptions</li> </ul>	<ul style="list-style-type: none"> <li>*Conceptual shortcomings identified in the majority of studies</li> <li>*Lack of agreement in definitions has impaired learning regarding the nature and effects of interruptions</li> <li>*Absence of theoretical underpinning regarding why interruptions might have adverse effects is also a problem</li> <li>*Reporting of interruption characteristics should be more rigorous and reliable</li> <li>*More studies of interruption handling required</li> </ul>
Grundgeiger and Sanderson, 2009	<ul style="list-style-type: none"> <li>*Currently a lack of evidence regarding extent to which interruptions lead to adverse effects</li> <li>*Most studies are descriptive in orientation and only a small number have examined outcomes regarding patient safety or errors</li> <li>*This point, as well as methodological shortcomings, likely accounts for the current lack of evidence re adverse effects (i.e. rather than the lack of a real, measurable association)</li> <li>*Interruptions might have positive, as well as negative, effects. Patient care might be improved but clinicians' cognition may be disrupted</li> <li>*Studying how interruptions are successfully managed, and their positive effects, might help</li> </ul>	<ul style="list-style-type: none"> <li>*Lack of shared definitions, and methodological heterogeneity, makes it difficult to compare studies, or to generalise findings</li> <li>* Many studies had small samples and rely on weak design</li> <li>*Little use of theory in existing studies. Theories of memory, such as Prospective Memory theory, may be particularly helpful since many researchers cite concerns</li> <li>*Studies don't adequately account for complexity of healthcare – nor the complexity of accidents</li> </ul>
Rivera-Rodriguez and Karsh, 2010	<ul style="list-style-type: none"> <li>*Interruptions occur frequently in healthcare</li> <li>*Frequency of interruptions likely reflects need for constant communication and coordination</li> <li>*Relatively few studies examined outcomes or effects of interruptions</li> <li>*Studying effects difficult because they might not be observable e.g. if effects involve cognitive or other 'invisible' processes</li> <li>*Interruptions may contribute to the safety and resilience of clinical systems. Trying to eliminate all interruptions therefore unwise</li> </ul>	<ul style="list-style-type: none"> <li>*Observations and other cognitive analysis methods might help identify effects of interruptions on clinicians' thinking processes</li> <li>*Research might examine positive effects of interruption – and study interruptions from the perspective of the person interrupting</li> <li>*Sociotechnical systems theory might help researchers view interruptions more holistically</li> </ul>
Hopkinson and Jennings, 2012	<ul style="list-style-type: none"> <li>*Little progress made in understanding nature or effects of interruptions</li> <li>*Few studies examined effects of interruptions – and few, if any, of these report meaningful evidence of such effects</li> <li>*Little is known about interruptions relate to the "entire repertoire" of nurses' work</li> <li>*Interruptions might have positive, as well as negative, effect</li> </ul>	<ul style="list-style-type: none"> <li>*Knowledge inhibited by lack of a common definition of interruption</li> <li>*Variation in study design and sampling methods, as well as differences in how events are categorised, impedes progress designs often weak.</li> <li>*Lack of theory used to guide studies also a weakness</li> </ul>
Raban and Westbrook, 2013	<ul style="list-style-type: none"> <li>*Studies provide only weak evidence regarding the effectiveness of interventions on either interruption- or error reduction</li> <li>*Only a small number of studies have examined interventions at this point, and they have used very different approaches to do this</li> <li>*Those involved in policy making should think carefully about implementing interventions designed to reduce interruptions at this stage.</li> <li>*More research needed to investigate the complex relationship between interruptions and errors</li> </ul>	<ul style="list-style-type: none"> <li>*Knowledge inhibited by lack of a common definition of interruption</li> <li>*Most studies have used 'before-and-after' designs that do not facilitate causal inference</li> <li>*Most were in a single setting and had small samples. Few performed statistical analysis</li> <li>*Controlled trials are needed to determine the effectiveness of interventions</li> </ul>

Each of the systematic reviews contributes unique insights, but consensus can be found on three key points: 1) distractions and interruptions occur frequently, and affect a range of clinicians; 2) studies vary considerably regarding how

distractions and interruptions are defined, the aims and research questions examined, settings, methods and sampling approaches; 3) studies share methodological weaknesses, relating, for example, to the use of small sample sizes, a reliance on 'subjective' methods (e.g. self-report), and the lack of a theoretical underpinning concerning why interruptions might result in adverse events (Grundgeiger and Sanderson, 2009; Biron et al., 2009b; Rivera-Rodriguez and Karsh, 2010; Raban and Westbrook, 2013).

These points (well, the second and third point) explain why three of the five reviews (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013a) concluded that the literature does not currently support the drawing of meaningful conclusions regarding the nature or effects of interruptions (beyond the notion that interruptions occur frequently, and affect a range of clinicians – point 1 above). Hopkinson and Jennings (2013a) summarised the problem as follows:

*Findings.. indicate little progress in advancing understanding of the nature or the influence of interruptions during acute care nurses' work. Knowledge development is inhibited by the lack of a common definition of what constitutes an interruption, the lack of similar sampling units, and the lack of designs that yield stronger evidence. The lack of consistent... classification terminology for interruptions further impede compiling findings into a meaningful synthesis.*

*Hopkinson and Jennings (2013a, p12)*

Similarly, Grundgeiger and Sanderson (2009) noted that:

*Several different definitions of interruptions are used, probably as a result of the differing research aims. This makes it difficult to compare and generalise results.... [studies] differ in their general research approaches... [and they] were conducted in different healthcare settings... Such heterogeneity in settings poses another challenge when we try to relate interruptions to errors; different tasks carried out by different personnel have been studied in different environments, which might be differently affected by interruptions. Grundgeiger and Sanderson (2009, p295)*

The apparent difficulty of drawing conclusions regarding specific research questions vis-à-vis interruptions (e.g. ‘what are the effects of healthcare interruptions’?) contributed to the decision to conduct a scoping review rather than a systematic review (i.e. since the latter, unlike the former, address very specific research questions).

## **2.3 PRIMARY LITERATURE REVIEW**

While the existing reviews provide useful insights, it would not be appropriate to rely on them in the context of a doctoral research study. A primary literature review was therefore undertaken. In the sections below, the definitions and aims adopted by studies of healthcare interruption are first examined, before a more detailed analysis of five different types of study is presented.

### 2.3.1 Definitions and Aims

Table 2-5 describes the definitions of interruption, and related phenomena, as well as the aims of extant studies. Due to the quantity of studies reviewed, only those published from 2009 onwards are included in Table 2-5. Corresponding tables for earlier studies are included in Appendix B – although reference is made to these studies in the text.

Focusing firstly on definitions, considerable variety can be seen in how interruptions have been defined and conceptualised (Brixey et al., 2007; Biron et al., 2009b; Grundgeiger and Sanderson, 2009; Coiera, 2012; Sasangohar et al., 2012; Hopkinson and Jennings, 2013b; Raban and Westbrook, 2013). Six specific points of disagreement are described in Table 2-4. Each definition was coded to establish its position vis-à-vis these six points, and the results of this exercise are presented in the shaded (grey and white) columns at the far end of Table 2-5. (The letters in the table relate to those enclosed in brackets in Table 2-4.)

*Table 2-4 Points of disagreement in definitions*

- |  |
|--|
| <ul style="list-style-type: none"><li>• Whether interruptions are tasks (T) that people must perform, events (E) that happen to people, or not specified (N)</li><li>• Whether interruptions are <i>necessarily</i> unplanned/ unexpected (U), or not specified (N)</li><li>• Whether interruptions are <i>always</i> externally imposed (E) (i.e. by other people or objects) or whether individuals can interrupt themselves in addition (EI), or whether it is not specified (N)</li><li>• Whether the initial task is <i>necessarily</i> suspended (S), or whether it is not specified (N)</li><li>• Whether interruptions <i>necessarily</i> involve communication (C) or whether they might involve other types of task or event / not specified (N)</li><li>• Whether interruptions are <i>necessarily</i> disruptive or problematic (D) or whether it is not specified (N)</li></ul> |
|--|



Table 2-5 Study aims and definitions

First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
Anderson et al., 2015	To examine the frequency of distractions and their impact on handoff quality P396	EFFECTS	Not stated						
Antoniadis et al., 2014	To observe interruption events in operating rooms (ORs) and to measure surgical team's intraoperative interference from interruptions during surgery. P21	COUNT + CAT	Events during the surgical procedure that potentially distract the OR team or OR member from a primary task or momentarily interrupt their task. P22 (also see P23)	E	N	N	N	N	N
Baethge and Rigotti, 2013	To investigate how interruptions affect perceptions of performance and irritation. P43	EFFECTS	Temporary suspensions of goal-directed action. P43	N	N	N	S	N	N
Ballermann et al., 2010	To evaluate whether a clinical information system in two ICUs in Edmonton, Canada is beneficial for patient care. P274	COUNT + CAT	Not stated						
Berg et al., 2013	To explore interruptions occurring during common activities of clinicians working in emergency departments. P656	COUNT + CAT	A break in the performance of a human activity initiated by a source internal or external to the recipient. This break results in the suspension of an initial task to perform an unplanned task P2. (Also self-interrupt p2)	E	U	EI	S	N	N
Biron et al., 2009a	To document the rate, sources, secondary tasks undertaken, duration and strategies employed by nurses to manage interruptions during medication administration P331	HANDLE	A break in the activity being performed to carry out a secondary task P330	T	N	N	S	N	N
Brixey et al., 2010	To examine doctors and nurses as initiators and recipients of interruptions. P109	COUNT + CAT	A break in the performance of a human activity initiated by a source internal or external to the recipient, with the occurrence situated within the context of a setting. P109	N	N	EI	S	N	N
Buchini and Quattrin, 2012	To record the frequency of interruptions and their causes, to identify avoidable interruptions and to build an improvement project to reduce avoidable interruptions. P326	COUNT + CAT	Any interruption diverts a nurse's attention from the task at hand such that interruptions and distractions are considered of equal importance. P1	N	N	N	N	N	N
Campbell et al., 2012	To determine the frequency and nature of distracting events to the anaesthetist throughout the entire anaesthetic process and to analyse the possible consequences these might have on the patient. P707	EFFECTS	Something which would not normally be considered within the anaesthetist's primary role of maintaining anaesthesia and appropriate physiological variables. P707	T	U	N	N	N	N

First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
Catchpole et al., 2013	To use human factors engineering to redesign the trauma process based on previously identified impediments to care related to coordination problems, communication failures, and equipment issues. P962	COUNT + CAT	Flow disruptions: deviations from the natural progression of a procedure that potentially compromise safety or efficiency P587	N	N	N	N	N	D
Catchpole et al., 2014	Recorded and classified flow disruptions during transition periods into seven categories P1	INTER-VENTION	Flow disruptions: deviations from the natural progression of an operation thereby potentially compromising the safety of the operation P963	N	N	N	N	N	D
Colligan and Bass, 2012	To understand how interruption management strategies during medical management could support the design of interventions to reduce and mitigate related errors. P1.	HANDLE	No explicit definition - but author notes that models of interruption have typically focused on task-switching when the primary task is suspended to attend to a secondary (interrupting) task. P2	T	U	N	S	N	N
Colligan et al., 2012	To decrease interruptions around a centrally located, centralised, open paediatric medication station P1	INTER-VENTION	Intrusion of a secondary unplanned and unscheduled task into a primary task (medication administration) P7	E	U	E	N	N	N
Conrad et al., 2010	To improve the physical design and layout of the medication room, reduce nurse interruptions and distractions, and create a standard medication process. P137	INTER-VENTION	None						
Cornell et al., 2011	To assess the cognitive impact of workflow on nurses. P407	COMPLEXITY	None						
Craig et al., 2014	To examine the most frequently observed interruptions experienced by nurses administering medications and evaluate an intervention designed to reduce those interruptions. P248	INTER-VENTION	Any emergent or non-emergent stimulus that halts the activity being performed for monitoring purposes or to carry out a secondary task.P2	T	N	N	S	N	N
De la Cruz et al., 2014	To compare time use and the number of interruptions between a group of emergency doctors using electronic records with typed data entry and a group using voice recognition data entry. P541	COUNT + CAT	A change in task with the previous task left incomplete or truncated. Completed tasks are those not needing any immediate follow-up after a change in task. P542	T	N	E	S	N	N
Edwards et al., 2009	To gain a better understanding of inter-clinician communication behaviours, routine workflow patterns, and the use of information communication technologies within the clinical workspace. P629	COUNT + CAT	Any disruptive activity, clinician conversation, event, or alert that occurred during a communication stream between two health care providers. P630	E	N	E	N	C	D
Elfering et al., 2014	To predict failure in action regulation that in turn predicts near-accidents in surgery and related health care. P1	EFFECTS	When.. attention must be diverted to the interruption agent and away from the current task P1	N	N	N	N	N	N

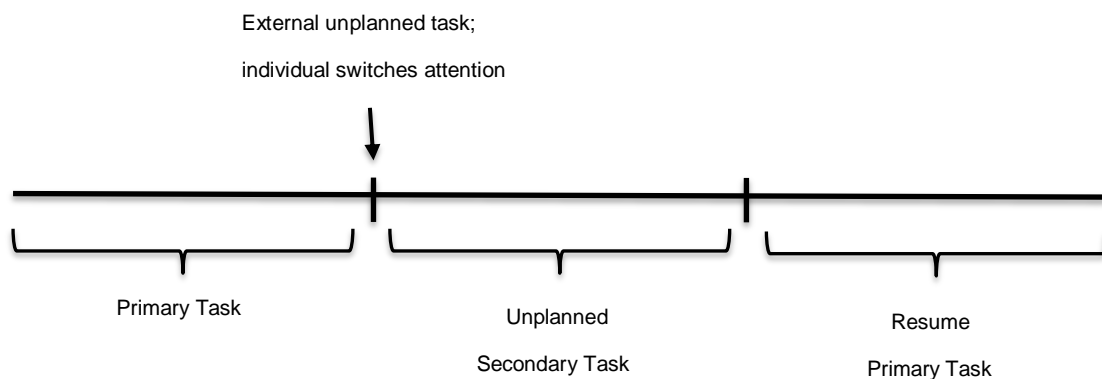
First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
Estry-Behar et al., 2014	To clarify the consequences of short shift change handovers on efficiency, team function, and quality of care P29	COUNT + CAT	Not stated						
Fore et al., 2013	To implement the sterile cockpit principle to decrease interruptions and distractions during high volume medication administration and reduce the number of medication errors. P106	INTER-VENTION	Any distraction not associated with passing meds (sic) P108	N	N	N	N	N	N
Freeman et al., 2013	To determine whether the implementation of a bundle of interventions would reduce interruptions during the medication administration process. A secondary goal was to reduce the number of medication errors reported. P179	INTER-VENTION	An event that occurred in the surrounding area that averted the nurses' concentration away from the primary focus of safely administering medication P179	E	N	E	N	N	N
Ghazanfar et al., 2012	To measure the time physicians spend on admission interviews and to describe factors that affect time consumption P1	COUNT + CAT	Not stated						
Grundgeiger et al., 2010	To investigate which properties of an interruption influence how long it takes nurses to resume interrupted critical care tasks. P317	EFFECTS	A hands off cessation of the primary task that leads to a discontinuity in the primary task (e.g., stopping medication preparation and turning to an alarm monitor)	N	N	N	S	N	D
Jeanmonod et al., 2010	To explore the nature of interruptions that occur during clinical practice in the emergency department. P376	EFFECTS	Not stated						
Kalisch and Aebbersold, 2010	To determine the number and type of interruptions and the amount of multitasking experienced by RNs and associated patient errors. P127	EFFECTS	Any event initiated by another person(s) or something else such as a call light or pager as well as an instance where the RN interrupted him- or herself. P128	E	N	EI	N	N	N
Klemets and Evjemo, 2014	To discover whether all interruptions caused by the wireless phones are unwanted. Further, it investigates how nurses handle these interruptions in a hospital setting. P670	HANDLE	Not stated						
Kliger et al., 2012	Spreading and sustaining a successful quality improvement P51	INTER-VENTION	Not stated						
Kosits and Jones, 2011	To determine (a) the frequency that a typical ED nurse experiences interruptions, (b) the type of interruptions a typical ED nurse experiences, and (c) the percentage of interruptions that take place during medication related activities. P3	COUNT + CAT	A break in performing a task that lasted longer than 10 seconds. P6	N	N	N	S	N	N

First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
McGillis Hall et al., 2010a	To explore interruptions in nursing work. P169	COUNT + CAT	Intrusions: 'unexpected encounters initiated by another person that interrupt(s) the flow and continuity of an individual's work and brings that work to a halt. P502	E	U	E	S	N	N
McGillis Hall et al., 2010b	To investigate the context of interruptions in nursing work. p168	COUNT + CAT	Externally generated, randomly occurring, discrete events that break continuity of cognitive focus on a primary task P167	E	U	E	S	N	N
McGillis-Hall et al., 2010	To examine interruptions to nurses work, the systems issues related to these and the associated outcomes. P1040	EFFECTS	Intrusions are unexpected encounters by someone else that interrupt the flow and continuity of the nurses' work bringing it to a temporary halt P1041	E	U	E	S	C	D
Palmer et al., 2013	To develop an initial methodology for identifying and classifying flow disruptions in the cardiac operating room. P1066	COUNT + CAT	Any disruption to the normal flow of operations. P1069	N	N	N	N	N	D
Pape, 2013	To reduce distractions and interruptions, save time for nurses in the process, and improve on-time delivery of medications. P212	INTERVENTION	An interruption is an attention-getting situation that changes the course of the task. A distraction is an event that attracts the person's attention away or interrupts the thought processes. P213	E	N	E	N	N	N
Redding and Robinson, 2009	To examine the type and frequency of work interruptions for nurses in medical-surgical hospital units. P194	COMPLEXITY	Not stated						
Relihan et al., 2010	To assess the impact of a set of interventions in reducing the interruption/distraction rate during medication administration. P1	INTERVENTION	An external factor causing the cessation of productive activity before a current task is complete. P8	N	N	E	S	N	N
Rivera, 2014	To understand the cognitive processes underlying nurses' decision to interrupt other nurses.	COMPLEXITY	An unplanned break in workflow caused by an external source (i.e. the interrupter). P2	E	U	E	S	N	N
Sasangohar et al., 2014	To explore the relations between the 3 Cs of interruptions: characteristics, context and content - and their use as a framework for studying interruptions. P848	COUNT + CAT	An external intrusion of a secondary task, which leads to a discontinuity in primary task. P1	T	N	E	S	N	N
Savoldelli et al., 2010	To quantify and analyse the frequency, the source and the impact of these events during the period of induction of general anaesthesia P683	EFFECTS	An event that could potentially or actually distract or interrupt anaesthetic team activity and hinder the workflow of the team. P684	E	N	N	N	N	D
Scott et al., 2010	Explored whether introducing drug round tabards reduced the number of interruptions during drug rounds and improved patient care and safety. P13	INTERVENTION	None						

First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
See et al., 2014	Used a simple observational method to describe the frequency, sources and severity of distractions, and delineate at-risk situations in our ICU P358	COUNT + CAT	Breaks in task activity, as evidenced by observed cessation of a task. P359	N	N	N	S	N	N
Sevdalis et al., 2014	Tested the hypothesis that intraoperative distractions are associated with deterioration in patient safety checks in the OR. P751	COUNT + CAT	Distraction: any event that occurs intraoperatively and that is not directly related to the care of the patient who is on the operating table at the time.P752	E	U	E	N	N	N
Smeulders et al., 2013	To examine the frequency and duration of interruptions and distractions during the medication rounds; to identify causes of the interruptions and distractions; and to compare differences in the interruptions between surgical and non-surgical units. P19	COUNT + CAT	Both an event initiated by another professional(s) or something else, and when a nurse interrupted him- or herself. P20	E	N	EI	N	N	N
Sorensen and Brahe, 2014	To investigate interruptions as they occur in clinical nursing practice in a typical hospital surgery ward in Denmark. P1275	COUNT + CAT	Breaks in nurses' work of more than five seconds P1275	N	N	N	S	N	N
Tomietto et al., 2012	To evaluate interruptions that occurred during medication rounds within a hospital-based, multi-intervention programme. P335	INTER-VENTION	A pause in an ongoing activity for either internal (e.g. nurse s decision) or external (e.g. environmental stimuli) reasons. P336	N	N	EI	S	N	N
Trbovich et al., 2010	To assess the nature and frequency of interruptions during medication administration and the interruptions' effects on task efficiency to guide healthcare managers/executives in improving patient safety and staff productivity. P211	COUNT + CAT	An interruption was defined as any externally initiated event (e.g. question from patient, telephone call, infusion pump alarm) that caused the nurse's attention to be diverted from a primary task. P212	E	N	E	N	N	N
Trbovich et al., 2013	To examine the nature, frequency, and impact of interruptions on oncologists' ordering practices. P127	EFFECTS	Any externally initiated event that caused the oncologists' attention to be shifted from a primary task... the oncologist may or may not pause primary task P130	E	N	E	S	N	N
Verweij et al., 2014	To evaluate the effect of drug round tabards on the frequency and type of interruptions, medication errors, the linearity between interruptions and medication error P340	INTER-VENTION	An event initiated by another professional(s) or something else, and when a nurse interrupted him- or herself. P341	E	N	EI	N	N	N
Weigl et al., 2011a	To examine the relationship of observed workflow interruptions with hospital doctors' perceived workload during day clinical shifts.	EFFECTS	An intrusion of an unplanned and unscheduled task, causing a discontinuation of tasks, a noticeable break, or task switch behaviour. P2	T	U	E	S	N	N
Weigl et al., 2011b	To quantify workflow interruptions among hospital doctors, identify frequent sources and relate sources to doctors' concurrent activities P491	COUNT + CAT	An intrusion of an unplanned and unscheduled task, causing a discontinuation of tasks, a noticeable break or task switch behaviour. P492	T	U	E	S	N	D

First Author, Year	Aim (page no.)	Category	Definition of Interruption (or similar phenomenon) (page no.)	Definition Type					
				Task, Event, None	Unplanned, None	External, Int/ Ext, None	Suspend, None	Comms, None	Disrupt, None
Weigl et al., 2012	Sought to estimate the effectiveness of a unit-based re-organisation of hospital physicians' daily work practices to reduce workflow interruptions. P607	INTER-VENTION	A secondary activity that requires one's attention and stops interaction with the primary activity. P606	T	N	E	S	N	N
Weigl et al., 2014	To determine the effects of a documentation-assistant intervention. P637	INTER-VENTION	An intrusion of an unplanned event that requires clinician's attention, causing a discontinuation of tasks, a noticeable break, or task switch behaviour. P639	E	U	N	S	N	N
Westbrook and Ampt, 2009	To design, apply and test an observational method... which would allow efficient, accurate and reliable data collection, and capture greater degrees of work complexity. PS25	COUNT + CAT	The ceasing of one task in order to attend to another task. P27	T	N	N	S	N	N
Westbrook et al., 2010a	Test the hypothesis that interruptions increase the risk of medications administration errors in hospitals. P684	EFFECTS	Situations in which a nurse ceased the preparation or administration task to attend an external stimulus P684	E	N	E	S	N	N
Westbrook et al., 2010b	To measure the association between emergency doctors' rates of interruption and task completion times and rates. P284	EFFECTS	Situations where a doctor ceased a current task in order to attend to an external stimulus. P284	E	N	E	S	N	N
Westbrook et al., 2011	To quantify how nurses distribute their time across tasks, with patients... and engagement with other healthcare providers; and how work patterns changed over a two year period P319	COUNT + CAT	Ceasing a task in order to respond to an external stimuli P8	E	N	E	S	N	N

While definitions disagree on a number of points, it is nevertheless possible to identify a traditional account of interruption to which many subscribe, to a greater or lesser. The traditional account, which is depicted in Figure 2-3, suggests that interruptions involve the suspension of a current task in order to attend to an externally imposed unplanned task or event. It is further assumed, in most cases, that the original task must be resumed at a later point. (See the following for further analysis of definitions: Brixey et al., 2007; Grundgeiger and Sanderson, 2009; Hopkinson and Jennings, 2013b; Sasangohar et al., 2012.)



*Figure 2-3 Traditional account of interruption*

Four further points implied by the traditional account include that: 1) there exists some objective stimulus for interruption i.e. an *external* event that indicates the need to switch to an unplanned task; 2) individuals have little choice regarding whether and/ or when interruptions can be handled (i.e. since the 'objective stimulus' demands immediate switching, more or less); 3) interruptions are intrinsically problematic e.g. since being forced to switch immediately is expected to have deleterious effects regarding ongoing activities; and 4) the main challenge of interruption relates to memory i.e. since remembering to resume the interrupted task, and recovering the task context, are seen as the central issues

(Brixey et al., 2008; Grundgeiger and Sanderson, 2009; McGillis-Hall et al., 2010; Rivera-Rodriguez and Karsh, 2010; Sasangohar et al., 2012).

Other phenomena described by researchers in relation to interruption, included distractions (Spencer et al., 2004; Collins et al., 2007; Rhoades et al., 2001; McGillis-Hall et al., 2010; McGillis Hall et al., 2010b Conrad et al., 2010; Fore et al., 2013; Buchini and Quattrin, 2012; Relihan et al., 2010; Smeulers et al., 2013); intrusions (Brixey et al., 2008; France et al., 2005; Antoniadis et al., 2014; McGillis Hall et al., 2010a; McGillis-Hall et al., 2010; Sasangohar et al., 2014; Weigl et al., 2011a; Weigl et al., 2014); and disruptions (Edwards et al., 2009; Palmer et al., 2013; Weigl et al., 2011a; Weigl et al., 2014; Sevdalis et al., 2007; Wiegmann et al., 2007).

Analysis of the aims and research questions of studies in Table 2-5 allowed the identification of five different study categories, as follows.

1. Counting and Categorising Studies – aimed to describe the frequency, type and causes of interruptions
2. Studies of Interruption Effects – examined the effects of interruptions on adverse events or other outcomes
3. Intervention Studies – investigated the effect of an intervention designed to reduce interruptions, or to improve care processes in some respect
4. Interruption Handling Studies – examined different strategies used by health professionals to manage distractions and interruptions
5. Studies of Healthcare Complexity – examined interruptions as part of a wider investigation of healthcare complexity



These categories are used to structure the remaining sections of the review. It should be noted that a number of studies could have been reviewed under multiple categories, however the need for brevity led to the decision to include each only once.

### **2.3.1.1 Counting and Categorising Studies**

Counting and categorising studies dominate the literature, accounting for 43 of the 93 studies included in the review. These studies record different aspects and ‘causes’ of interruptions. Table 2-7 describes the settings, participants, methods, and key results of the counting and categorising studies for studies published after 2009 (see Appendix B for earlier studies). It also includes, in the penultimate column, analysis of the different interruption aspects (specific elements of interruption) that have been reported by researchers. These were coded in accordance with a list of interruption aspects described by Hillel and Vicente (2003), presented in Table 2-6.

*Table 2-6 Key interruption aspects (adapted from Hillel and Vicente, 2003)*

- |   |
|---|
| <ul style="list-style-type: none"> <li>• <b>Primary Task:</b> the task being performed at the time of interruption</li> <li>• <b>Secondary Task:</b> the additional task that the individual is required to perform</li> <li>• <b>Interruption Source:</b> the clinician, patient, or other individual, requesting the additional task</li> <li>• <b>Interruption Medium:</b> the communication channel, or technology, used to convey the interruption (e.g. face-to-face, email, pager, machine alarm etc)</li> </ul> |
|---|

*Table 2-7 Key features of counting and categorising studies*

First Author, Year, Country	Setting	Participants / sample	Methods	Interrupt aspects reported	Results
Antoniadis et al., 2014, Germany	Two surgical clinics in German hospital (abdominal and orthopaedic surgery).	A total of 65 procedures were sampled	Structured observation	Source, Medium	Some 803 interruptions and disruptions were observed. Surgical teams were distracted or interrupted c.10 times per hour on average. Most interruptions were attributed to equipment failures and environmental factors. Some clinicians were interrupted more often than others, while more interruptions occurred during earlier stages of surgeries.
Ballermann et al., 2010 Canada	Two ICUs in Edmonton Canadian Teaching Hospital	Some 97 nurses and 34 physicians were observed. Physicians included chief residents and specialty fellows	Structured observation, unstructured observation	Secondary	Interruption rates varied according to the charting medium used. Physicians were interrupted less frequently when using the clinical information system to support documentation, than when using other methods to achieve the latter. In contrast, nurses were interrupted more frequently when charting using the clinical information system. The data suggested that physicians avoid interruptions when the system does not support (interrupted) task resumption
Berg et al., 2013 Sweden	Two Swedish emergency departments	18 clinicians, licensed practical nurses, registered nurses and medical doctors	Structured interview, structured and unstructured observation	Primary, Medium	Just over 5 interruptions occurred per hour on average – although interruptions were not considered to be negative events necessarily. Interruptions were most common during information exchange tasks. Nurses' and doctors' stations were the most frequent location of interruptions, while doctors were interrupted more often than other clinicians. Some 1/10 interrupted tasks were not resumed.
Brixey et al., 2010 US	Trauma section of a level one trauma centre.	Five attending trauma doctors and eight RNs observed	Unstructured observation	Source Medium	Medical doctors and nurses received more interruptions than they initiated. Most interruptions occurred through face-to-face interactions, although telephone interruptions were also quite common.
Buchini and Quattrin, 2012 Italy	An intensive rehabilitation ward in Northern Italy	18 nurses were invited to participate in the study.	Structured observation	Secondary	Almost 1200 interruptions were observed, and 14 antecedent causes were identified. Some 9 out of the 14 different types of interruption observed were considered avoidable by nurses.
Catchpole et al., 2013, US	Emergency department of level 1 academic hospital	Some 181 patients observed from arrival in the emergency department to discharge	Semi-structured observation	Primary, Secondary	Some 2/3 patient encounters were interrupted. The most common reason for interruption – explaining just over half of these events – was the need to handle coordination problems. Patients who had immediate surgery, or who needed to be admitted to the intensive care unit, were significantly more likely to receive flow disruptions than others.
De la Cruz et al., 2014, US	Two academic teaching hospitals in the US	Unstated number of physicians. Total observation period over 4000 minutes	Structured observation	Primary, Secondary	Doctors spent slightly less time charting when using the voice recognition system than when using a manual (typing) data entry system – but the difference was not significant. Manual data entry was associated with significantly higher interruption rates than was voice recognition
Edwards et al., 2009 US	ED in one large tertiary teaching hospital and one mid-size acute care hospital.	Seven attending physicians (6 emergency physicians and 1 internal physician) and two emergency nurses participated	Structured observation	Source	Clinicians spent most of their time on patient care – although the majority of this involved indirect care tasks such as charting. Clinicians preferred using synchronous communication methods, although these were associated with more frequent interruptions and multitasking rates. Both attending physicians and nurses received more interruptions than they initiated.

First Author, Year, Country	Setting	Participants / sample	Methods	Interrupt aspects reported	Results
Estryn-Behar et al., 2014, France	Various settings in 4 French hospitals (2 academic, 2 general) incl oncology, medical, dermatology, urology	29 RNs, 18 nursing assistants, 14 physicians	Structured observations; interruptions described qualitatively.	Secondary	Morning patient/ shift handovers lasted 15 minutes on average, while evening ones lasted 13 minutes. Clinicians spent around 16% of their time handling interruptions, and they switched tasks 260 times per work shift on average. Time spent on interruptions was similar for nurses, nursing assistants and doctors.
Ghazanfar et al., 2012 Denmark	An acute medicine department in a 90-bedded hospital in Region Zealand	Fifty patient admission interviews conducted by 17 physicians were observed.	Structured observation	Primary, Secondary, Source, Medium	Admission interviews lasted 45 minutes on average – although 1/3 of this time was spent on interviewing and examining the patient, and obtaining medication history. Between 0 and 9 interruptions occurred per interview, and most were caused by phone calls, or by nurses asking for advice. The average interruption duration was 7 minutes.
Kosits and Jones, 2011 US	Emergency departments of a major metropolitan academic medical centre	A convenience sample of 30 nurses from 3 emergency departments	Structured observation	Primary, Secondary, Source, Medium	Just over 3 interruptions occurred per hour on average. Most interruptions involved face-to-face communications with other staff working in the emergency department. 1 in 4 interruptions related to medication activities.
McGillis Hall et al., 2010a Canada	Some 6 medical-surgical units from 3 Canadian teaching hospitals	30 nurses participated in the study	Structured observation	Primary, Secondary, Source	Almost 1700 interruptions were observed. Some 90% were thought to (potentially) decrease safety, while 10% increased safety. The most common interruption sources were the healthcare team, other nurses, relative visit, and the ward environment. 1 in 20 interruptions involved self-interruption
McGillis Hall et al., 2010b Canada	Four units in paediatric teaching hospital. Surgical, complex medical-surgical, critical care and medical.	32 nurses observed. A total of 380 hours of observation was conducted.	Structured observation, focus group	Primary, Secondary, Source	Nurses experienced more than 5000 interruptions during the period of observation. Most interruptions emanated from other people – especially other clinical staff and patients. Aspects of the physical environment and nurses' organisational abilities also contributed to interruptions – but far less frequently.
Palmer et al., 2013 US	Cardiac operating room (OR) in a large hospital	10 cardiac operations were observed	Structured observation	Secondary, Source	The most common reason for disruptions related to the layout/ design of the operating room. Other key reasons for disruption included communication, usability problems, environmental hazards, and equipment failures.
Sasangohar et al., 2014 Canada	Cardiovascular ICU of a Canadian teaching hospital	40 nurses of the cardiovascular ICU (CVICU) of a Canadian teaching hospital	Structured observation	Primary, Secondary, Source, Medium	Just over half of the observed interruptions occurred during safety critical tasks. However, many of these interruptions (also over half) involved the communication of important task or patient information. Low importance interruptions (e.g. those relating to personal conversations) occurred significantly less during safety-critical activities, suggesting sensitivity on the part of potential 'interrupters'.
See et al., 2014 Singapore	A 20-bed medical ICU of a 1,000-bed tertiary-care hospital	A total of 11 doctors were observed	Structured observation	Source	Just over 4 distractions occurred per hour on average, and the median duration was 2 mins. The main initiators of distraction were, in descending order, other doctors, nurses, and self-interruption. 1 in 4 distractions lasted more than 5 minutes. None of the variables (physician experience, time and day of week) examined significantly predicted distraction frequency rates.

First Author, Year, Country	Setting	Participants / sample	Methods	Interrupt aspects reported	Results
Sevdalis et al., 2014 UK	Urology operating room in a UK teaching hospital	Examined 24 elective urology surgeries – each involving the same surgeon.	Structured observation	Primary, Secondary, Source	Mean surgery duration time was 70 min. Some 4 communication distractions and c.2.5 other distractions occurred per surgical case, with an overall frequency of 1 every 10 minutes. Distractions regarded as most disruptive were those emanating from external visitors, and those caused by lack of coordination between hospital departments. Communication distraction frequency was associated with lower patient check completion.
Smeulders et al., 2013 Netherlands	Surgical and non-surgical units (unspecified)	A total of 39 medication rounds were observed over a 2-week period	Structured observation	Source, Medium	Interruptions occurred 7 times per hour on average. The most frequent interruption sources were nursing colleagues and non-verbal interruptions from the ward environment (e.g. conversations taking place in the vicinity of the nurse, cleaning work). Interruptions were more frequent and took longer to deal with during the morning medication rounds (when compared with afternoon rounds) and in non-surgical units (compared with surgical units).
Sorensen and Brahe, 2014 Denmark	A single surgical ward in a Danish hospital	5 nurses	Semi-structured observation, unstructured interview	Primary, Secondary, Source, Medium	Interrupting (secondary) tasks most often involved the need to answer questions from nurse colleagues. The most interrupted (primary) tasks were formal medicine preparation tasks. Nurses considered some interruptions as more avoidable and necessary than others.
Trbovich et al., 2010 Canada	A chemotherapy day-care unit at a cancer treatment teaching hospital in Canada	Observers shadowed 17 nurses over a period of 3 hours each as they administered medications	Structured observation	Primary, Secondary, Source	Nurses spent more than 1/5 of their time dealing with interruptions while performing safety-critical tasks. Task completion times were notably longer for interrupted tasks than for uninterrupted tasks.
Weigl et al., 2011b, Germany	Four wards (general surgery, trauma surgery, cardiology, gastro-enterology) in a large teaching hospital	32 participant observations of doctors' full work shifts were carried out.	Structured observation	Primary, Secondary, Source, Medium	Interruptions occurred frequently in all settings – but they were especially high in the intensive care unit and the emergency ward. The need to answer telephones and beepers accounted for most interruptions. The probability of any given type of interruption varied according to the type of current (primary) task being performed. Telephone or beeper interruptions for example occurred more often when doctors were communicating with patients.
Westbrook and Ampt, 2009, Australia	Four wards (respiratory, renal/vascular and two geriatric), at a teaching hospital in Sydney	52 nurses were observed for 250 h	Structured observation	Primary, Secondary	More than 2/5 of nurses' time involved direct care or work-related communication. Nurses were interrupted once every 50 or so minutes on average. Around 1/4 interruptions occurred while nurses were involved in medication preparation or administration activities.
Westbrook et al., 2011 Australia	Two general medical and surgical wards of a Sydney teaching hospital	57 nurses observed for 191 hours	Structured observation	Primary, Secondary	Nurses spent just under 2/5 of their time with patients, and this did not change over time. Nurses completed more than 70 tasks per hour, and the mean task duration was a little under 1 minute. Interruptions occurred twice per hour and nurses spent 1/4 of their time multitasking. Medication tasks were responsible for 1/4 interruptions – more than any other task.

Counting and categorising studies have helped to quantify the scale of interruptions, and raised awareness regarding their potential implications (Grundgeiger and Sanderson, 2009; Hopkinson and Jennings, 2013b; Coiera, 2012). The extant literature suggests that interruptions occur frequently in a range of healthcare settings (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013b; Coiera, 2012) – and that they affect a variety of clinicians (Grundgeiger and Sanderson, 2009; Westbrook et al., 2010a; Walter et al., 2013; Sanderson and Grundgeiger, 2015).

Counting and categorising studies however are not without shortcomings. Perhaps the most fundamental relates to their failure to illustrate why interruptions matter (Grundgeiger and Sanderson, 2009; Magrabi et al., 2010; Li et al., 2012; Coiera, 2012). Almost all ‘counting’ studies cite the potential for interruptions to undermine patient safety (e.g. Trbovich et al., 2010; Sorensen and Brahe, 2014; Sasangohar et al., 2014; Ghazanfar et al., 2012; Healey et al., 2006; Chisholm et al., 2001; Brixey et al., 2008), or disrupt the flow of work (e.g. Baethge and Rigotti, 2013; Weigl et al., 2014; Weigl et al., 2011a; Palmer et al., 2013; McGillis Hall, 2010a; McGillis Hall, 2010b; Sevdalis et al., 2008; Wiegmann et al., 2007), as a rationale for the research – yet none attempt to demonstrate this.

While it might be argued that descriptive and exploratory studies are required first, before the effects of interruptions are examined (i.e. because it is difficult to understand the effects of a phenomena without first understanding the phenomena itself), this argument appears in few, if any, studies. Furthermore, better approaches might be suggested for exploring and describing interruptions

than merely counting and categorising events. More inductive, qualitative approaches for example might have provided richer data and facilitated new discoveries (Berg et al., 2013; Creswell, 2007).

In terms of the methods used by counting and categorising studies, most studies employed a single method – and in almost all cases this involved structured observations. (Studies by Blum and Lieu, 1992, Brixey et al., 2010, and Catchpole et al., 2013 were notable exceptions.) The relative ease of conducting structured observations, as well as their ability to facilitate coding and categorising of events and behaviours, helps to explain their popularity. However, as with any method, structured observations have limitations, and a more complete understanding might have emerged had individual researchers employed multiple methods – or had the literature as a whole embraced a wider range of approaches (Grundgeiger and Sanderson, 2009; Li et al., 2012).

Researchers' reliance on structured observations, and associated coding systems, might be less problematic if these were developed systematically. Unfortunately, few studies provided detailed information regarding the development of their coding schemes (Grundgeiger and Sanderson, 2009; Walter et al., 2015; Raban and Westbrook, 2013). (Notable exceptions include Sasangohar et al., 2014; Brixey et al., 2010; Weigl et al., 2011b; Raban and Westbrook, 2013; Walter et al., 2015.) Furthermore, the way in which these schemes were operationalised lacks clarity; it is not clear in many cases how different aspects of interruption were measured and recorded, for example.

Another concern relates to the heterogeneity in different aspects of interruption reported by researchers. This can be seen most easily in the penultimate column

of Table 2-7, where even a cursory glance at the coded data reveals huge variety in the aspects reported. (The reader should note in interpreting the coded data that researchers used a wide variety of terms to describe the events reported i.e. few used the same terms as Hillel and Vicente, 2003.) While individual researchers should not be criticised for reporting different events, or describing interruption aspects in different ways, the lack of a common framework nevertheless makes it difficult to synthesise the literature as a whole, or to draw many meaningful conclusions.

An additional finding highlighted through analysing the different interruption aspects reported by researchers concerns the lack of complete information regarding primary *and* secondary tasks. Given that most researchers defined interruptions in terms of a switch *from* a primary task *to* a secondary task, one might expect to see detailed information regarding both types of task. This might be expected to include not only details of the most common primary and secondary tasks, but also specification regarding *which* primary tasks led to *which* secondary ones.

Given the above reasoning, it is surprising to learn that just 12 of the 23 studies in Table 2-7 reported both primary *and* secondary tasks – and none of these studies specified precisely *which* primary tasks led to *which* secondary ones.<sup>4</sup>

A further concern relates to the reliability of the data reported by counting and categorising studies. Many researchers fail to describe how rater reliability was assessed, or fail to provide data to support this (Grundgeiger and Sanderson,

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<sup>4</sup> Studies in which the primary task was always the same (because the study examined interruptions to one particular task) were excluded from this analysis.

2009; Biron et al., 2009b; Walter et al., 2015). More recent studies however were more likely to report reliability data (e.g. see Kosits and Jones, 2011; Westbrook et al., 2011; Sasangohar et al., 2014; Antoniadis et al., 2014).

Further weaknesses of counting and categorising studies relate to sampling. Table 2-7 shows that most studies were conducted in just one setting, and most used small samples (Grundgeiger and Sanderson, 2009; Hopkinson and Jennings, 2013b; Walter et al., 2015). A small number of recent investigations however obtained much larger samples (Westbrook et al., 2010a; Walter et al., 2013; McGillis-Hall et al., 2010), providing greater confidence in the findings.

The specific sampling techniques employed by researchers also presents limitations (Grundgeiger and Sanderson, 2009; Raban and Westbrook, 2013; Walter et al., 2015; Sanderson and Grundgeiger, 2015). The vast majority of studies used convenience sampling, with settings and participants chosen on the basis that they could be easily accessed. The lack of probability sampling limits the degree to which data might be considered 'representative' of the wider group of settings or clinicians involved (Bryman, 2012a; Grundgeiger and Sanderson, 2009; Magrabi et al., 2010; Sanderson and Grundgeiger, 2015). The reader is left to wonder in many cases whether study findings accurately reflect work in the particular setting – let alone whether results might have wider relevance. (Few studies claim explicitly to provide a representative view – and there are other reasons for studying phenomena that do not require this.<sup>5</sup>)

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<sup>5</sup> For example, to provide a better understanding of a phenomena, which might support theory building (Charmaz, 2006).



The difficulty of generalising the findings of counting and categorising studies is further exacerbated by the lack of detail provided by researchers regarding study settings. Further information about the clinical context might have allowed readers to better assess the applicability of findings to the environments with which they are familiar.

### ***2.3.1.2 Studies of Interruption Effects***

Table 2-8 describes the aims, settings, participants, methods and outcome measures studied by researchers interested in the effects of interruptions for studies published after 2009 (see Appendix B for earlier studies). Key findings of these investigations are also summarised.

That only a small proportion (19 of the 93 studies) of studies included in the review examined the effects of interruptions is surprising – especially given that most cite such effects (e.g. on safety) as the main rationale for the research (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Magrabi et al., 2011). Researchers who attempted to investigate such issues should therefore be credited for focusing on what is arguably the most important aspect of interruptions.

*Table 2-8 Key features of interruption effects studies*

First Author, Year, Country	Aim (page no.)	Setting	Participants / sample	Methods	Outcome measures	Results
Anderson et al., 2015, US	To examine the frequency of distractions and their impact on handoff quality. P396	Multiple surgical services (incl vascular, plastics, traumas) in 3 teaching hospitals	Some 214 surgical handoffs (184 residents, 34 moonlighters)	Structured observation	Interruption rate, handoff quality	Pages were the most common distraction, followed by telephone calls. Distractions were present in 48% of resident handoffs, 54% of junior resident handoffs, 30% of moonlighter handoffs, and 38% of senior resident handoffs. Distractions more common during evening than morning handoffs. Handoff quality ratings were not affected by distractions
Baethge, 2013 Germany	To investigate how interruptions affect perceptions of performance and irritation by employing a within-person approach. P43	Various types of ward across 10 German hospitals	133 nurses	Diary study	Self-rated performance, irritation, remembering tasks	Workflow interruptions found to have negative effects on self-rated performance, the forgetting of intentions, and irritation. The mediation effects of mental demands and time pressure were supported for irritation and (partially) supported for satisfaction with performance. They were not supported for the forgetting of intentions.
Campbell et al., 2012, UK	Aimed to determine the frequency and nature of distracting events to the anaesthetist throughout the entire anaesthetic process and to analyse the possible consequences these might have on the patient. P707	Anaesthetic rooms attached to operating theatres in a UK hospital	Observed 30 anaesthetic inductions in various settings, for 31 hours. Interviewed 15 anaesthetists	Structured observation, Interviews	Whether distraction had a negative or positive effect. Interrupt of anaesthesia seen as a negative outcome	The frequency of distractions was 0.23 per minute. 22% events had a negative effect, and 3% a positive one. Distraction management strategies included ignoring inappropriate intrusions or conversation; asking staff with non-urgent matters to return later at a quieter time preparation, and checking of drugs and equipment ahead of time.
Elfering, 2014 Switzerland	To predict failure in action regulation that in turn predicts near-accidents in surgery and related health care. P1	Operating theatre staff from 8 Swiss hospitals	Some 133 (of 312 invited) theatre nurses and physicians from 8 Swiss hospitals returned surveys	Questionnaire	Failure in action regulation, near-accidents	Structural equation modelling identified an indirect path from workflow interruptions (through failure in action regulation) to near-accidents. The indirect path was stronger for interruptions by 'malfunctions' and 'organisational blockages' compared with interruptions by persons.
Grundgeiger, 2010 Australia	To investigate which properties of an interruption influence how long it takes nurses to resume interrupted critical care tasks. P317	The study was conducted in a tertiary ICU in a German hospital	10 ICU nurses participated	Coded eye tracking and video-recorded data	Interrupted-task resumption time (incl never resumed)	Some 570 distractions were coded. Nurses often used behavioural strategies that made it impossible to identify a resumption lag (e.g. the task was finished before the nurse addressed the interruption). In 7% of the observed interruptions, nurses did not return to the task, resumption was not necessary, or some other factor prevented resumption.

First Author, Year, Country	Aim (page no.)	Setting	Participants / sample	Methods	Outcome measures	Results
Jeanmonod, 2010 US	To explore the nature of interruptions that occur in the emergency department (ED). Also examined effects of clinician interruptions occurring at the bedside on patient satisfaction P376	Emergency department of large tertiary care centre	Physicians were observed for over 132 hours. Number of physicians not stated	Structured observation	Patient satisfaction	Physicians were commonly interrupted in all clinical activities –but most frequently during reviewing of data (53%) and charting (50%). Bedside interruptions occurred 26% of the time, and had a negative impact on patient satisfaction. The majority of interruptions (60%) were initiated by another healthcare provider (physician or nurse). Interruptions only rarely resulted in a physician changing tasks before completion.
Kalisch, 2010 US	To determine the number and type of interruptions and the amount of multitasking experienced by RNs and associated patient errors. P127	35 med-surg units 1 intensive care unit, 1 post cardiac unit; Teaching hospital	36 nurses, 136 hours of observation	Structured observation	Error rate	More than 1300 interruptions were observed and some 200 errors. Interruption rates varied between hospitals, but on average, nurses were interrupted 10 times per hour. The error rate on the other hand was 1.5 times per hour – although again there was variation between hospitals. Errors were not significantly associated with interruptions.
McGillis-Hall et al., 2010 Canada	To examine interruptions to nurses work, the systems issues related to these and the associated outcomes. P1040	36 medical and surgical units in nine adult, acute care teaching hospitals across three provinces	360 nurses were observed over almost 3000 hours	Structured observation, focus group	Coded whether outcome was positive or negative	Members of the wider healthcare team were the main sources of interruption, followed by other nurses. Some 90% of interruptions were thought to have negative effects, while just 10% had positive outcomes. Results were broadly consistent across the two ward types.
Savoldelli, 2010 Switzerland	The purpose of this study was to quantify and analyse the frequency, the source and the impact of these events during the period of induction of general anaesthesia P683	Induction room of the emergency operating theatre of the Geneva University Hospitals.	29 anaesthetic team members – incl 16 physicians and 13 nurse anaesthetists.	Coded video data	Coded positive and negative outcomes, plus task handling categories. Interruption seen as a negative outcome	The results show that the sources of distracting events are multiple and diverse. Distractions occurred frequently and clinicians spent around 40% of the time dealing with these. Distractions had a significant impact on the activity of the team members for 22% of the observed time, and they had a negative impact on patient management in one-fifth of the cases. They also had a positive impact on patient management in some cases.
Weigl, 2011a Germany	To examine the relationship of observed workflow interruptions with hospital doctors' perceived workload during day clinical shifts. P43	300-bed municipal teaching public hospital. Surgery and internal medicine wards	29 doctors working in internal medicine and surgical specialties	Structured observation, Questionnaire	Doctor's workload	Hospital doctors were on average disrupted 4 times per hour. Most frequent were interruptions by nursing staff, telephone/beeper interruptions and by fellow doctors. Senior doctors reported higher workload than their junior colleagues. Overall workflow interruptions were significantly related to doctors' workload. Further analyses revealed that doctors' workload was associated particularly with interruptions by nursing personnel.

First Author, Year, Country	Aim (page no.)	Setting	Participants / sample	Methods	Outcome measures	Results
Westbrook, 2010a Australia	Test the hypothesis that interruptions increase the risk of medications administration errors in hospitals. P684	6 medical & surgical units 2 major teaching hospitals Australia	98 nurses (63 nurses across 4 wards in hospital A and 35 nurses across 2 wards at hospital B)	Structured observation	Procedural failure, errors in medication admin	Interruptions were associated with a slightly (but significantly) increased risk in procedural failures and clinical errors. Interruptions occurred in just over half of drug administrations. Some 3/4 drug administrations involved a procedural failure, while 1/4 involved a clinical error. Nurse experience was not related to clinical errors, and was associated with slightly higher procedural failure rates. The severity of errors increased with interruption frequency.
Westbrook, 2010b Australia	The aim was to measure the association between emergency doctors' rates of interruption and task completion times and rates. P284	ED of large urban teaching hospital	40 doctors (5 emergency physicians, 7 medical registrars, 21 residents, 7 interns) observed for 210 hours.	Structured observation	Average time-on-task, resuming interrupted tasks	Doctors were interrupted about 7 times per hour on average. 1 in 10 tasks were interrupted, and 3% of tasks were interrupted more than once. Interruptions were associated with a significant increase in time-on-task – but when the analysis controlled for the fact that longer interruptions are more likely to be interrupted (i.e. since there is more opportunity to interrupt over a longer period) interrupted tasks were completed faster than uninterrupted tasks. Doctors failed to return to 1/5 interrupted tasks.

One of the most striking aspects of cause-and-effect studies (hitherto described as 'causal' studies) concerns the heterogeneity of their aims. Studies examined the effects of interruptions on a range of outcomes, including patient satisfaction (Jeanmonod et al., 2010), error rates (Flynn et al., 1999; Palese et al., 2008; Christian et al., 2006; Hillsden and Fenton, 2006; Kalisch and Aebbersold, 2010; Westbrook et al., 2010a; Grundgeiger and Sanderson, 2009), disruptions in workflow (Wiegmann et al., 2007; Zheng et al., 2008), and remembering to resume interrupted tasks (Grundgeiger and Sanderson, 2009; Baethge and Rigotti, 2013; Westbrook, 2010a).

Study settings were also diverse, although there were some commonalities. Two studies included intensive care units (Grundgeiger et al., 2010; Kalisch and Aebbersold, 2010), two were conducted in emergency settings (Jeanmonod et al., 2010; Westbrook et al., 2010b), and seven involved a surgical or anaesthesia setting (Christian et al., 2006; Savoldelli et al., 2010; Elfering et al., 2014; Campbell et al., 2012; Anderson et al., 2015; Zheng et al., 2008; Wiegmann et al., 2007).

The majority of studies (10 of the 19) were conducted in more than one ward/unit (Anderson et al., 2015; Baethge and Rigotti, 2013; Campbell et al., 2012; Elfering et al., 2014; Kalisch and Aebbersold, 2010; McGillis-Hall et al., 2010; Weigl et al., 2011a; Westbrook et al., 2010a; Palese et al., 2008; Wiegmann et al., 2007). Just a handful of studies, however, took place in multiple hospitals (Anderson et al., 2015; Baethge and Rigotti, 2013; Elfering et al., 2014; McGillis-Hall et al., 2010; Westbrook et al., 2010a). More recent studies were more likely to take place in multiple wards – or multiple hospitals in fact – than older ones.

Just two of the seven studies published prior to 2009 took place in multiple wards (Palese et al., 2008; Wiegmann et al., 2007), while none of these were conducted in multiple hospitals.

It is worth noting at this point that ‘causal’ studies are similar in most cases to counting and categorising studies, in the sense that they involve observing and coding interruption-related events (albeit causal studies have tended to describe one or more of these events as an ‘outcome measure’). It might not be surprising to learn, therefore, that the studies share similar shortcomings regarding event coding and reporting. Few studies, for example, provided detailed information regarding the development of their coding schemes, or the way that key variables were recorded and measured (Grundgeiger and Sanderson, 2009; Walter et al., 2015; Raban and Westbrook, 2013) – although there were exceptions (e.g. Grundgeiger et al., 2010; Westbrook, 2010a). There was also a lack of consistency in the reporting of interruption aspects – a point which can be verified by even a quick look at the study results (in the far right column of Table 2-8). Finally, few researchers provided full details of the primary-secondary task switch (i.e. they do not specify *which* primary tasks led to *which* secondary ones), despite most defining interruptions in relation to such a task switch (Table 2-8). All of this further emphasises the lack of a shared conceptual understanding regarding healthcare interruptions.

Causal studies were less likely to rely on structured observation than were counting and categorising studies, but they nevertheless used this, or a related approach (e.g. coded video data), in almost all cases (see Methods column in Table 2-8). The use of video methods seemed useful in several studies since they facilitated more precise data collection (Flynn et al., 1999; Zheng et al.,

2008; Savoldelli et al., 2010; Grundgeiger et al., 2010). Two researchers should be applauded for using methods to capture clinicians' perceptions of interruptions, which might be important given that these might play a role in how these events are handled (Baethge and Rigotti, 2013; Elfering et al., 2014). The reliance in these studies however on subjective perceptions is a concern given individual biases that might affect these (e.g. memory, self-serving biases etc).

Just 4 of the 19 studies employed a qualitative method, and in each case this was considered 'secondary' (i.e. it was used to supplement another method: Baethge and Rigotti, 2013; Campbell et al., 2012; McGillis-Hall et al., 2010; Christian et al., 2006). Greater use of qualitative methods, such as ethnographic observations (as opposed to structured observations) might have provided richer data regarding the nature and circumstances of interruptions, and illuminated the role this (might have) played in shaping their effects. It is a common misconception that qualitative methods cannot be used to support the identification of cause-and-effect (Curry et al., 2009).

Three additional areas for development in causal studies relate to how causality is conceptualised in the context of interruptions. First, healthcare systems are complex and, to some extent, they are designed to be 'resilient' (Holden et al., 2011; Nemeth, 2011). Clinicians are expected to intervene to prevent accidents, meaning that individual failures, such as those that might result from interruption, might not result in serious errors (Grundgeiger and Sanderson, 2009; Sasangohar et al., 2012; Rivera, 2014). The implication is that any effects of interruption will likely be mediated by various aspects of the immediate clinical context – yet researchers have tended to discuss such effects in terms of a simple stimulus-response relationship, i.e. as though interruptions inevitably lead

to adverse events (Grundgeiger and Sanderson, 2009; Sasangohar et al., 2012; Rivera, 2014). A notable exception here concerns the study of Elfering et al., (2014), which attempted to model the mediating role of “action regulation” (self-regulation of individual cognition) on the relationship between interruptions and near accidents.

A second way in which the understanding of causality might be improved concerns the use of theory to support understanding of interruptions’ effects (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013b). Theories regarding human cognition might prove particularly useful since the ability to consider efficient ways of handling events might prove powerful (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013b). While many studies note the potential of interruptions to disrupt memory, just two have drawn on memory theories to highlight potential effects (Grundgeiger, 2010; Baethge and Rigotti, 2013). Cognitive theories regarding action regulation (Elfering et al., 2014) and concentration (Baethge and Rigotti, 2013) have also been drawn on, but other potentially relevant theories, regarding naturalistic decision making (Klein, 2008; Klein, 1993) for example, have not.

The third and final aspect of causality vis-à-vis interruption that deserves attention concerns the widespread assumption that the effects of interruptions are negative. A number of researchers have pointed out that interruptions might be beneficial in some respects – for example they might facilitate communication or situation awareness (Brixey et al., 2004; Potter et al., 2005; McGillis-Hall et al., 2010; Grundgeiger and Sanderson, 2009; 2009; Rivera-Rodriguez and Karsh, 2010; Walter et al., 2015). However, just three of the ‘causal’ studies



considered positive effects of interruption (Savoldelli et al., 2010; Campbell et al., 2012; McGillis-Hall et al., 2010) – and the approach they took can be criticised because they did not describe in detail how ‘positive’ or ‘negative’ was determined.<sup>6</sup> This would seem a difficult discrimination to make, hence clarity regarding how it was done would be important (Rivera-Rodriguez and Karsh, 2010; Rivera, 2014; Sanderson and Grundgeiger, 2015).

Further shortcomings related to sampling. Few researchers described how they determined the appropriate sample size (e.g. using power calculations), and the majority included small samples. Two studies involved the observation of just 10 patient cases (Grundgeiger et al., 2010; Christian et al., 2006), while most others involved observation of fewer than 50 clinicians (Westbrook et al., 2010a; Kalisch and Aebersold, 2010, Savoldelli et al., 2010, Wiegmann et al., 2007, Hillsden and Fenton, 2006; Scott-Cawiezell et al., 2007; Palese et al., 2008; Zheng et al., 2008). Most studies used convenience sampling and it is not clear whether findings might be applicable to other settings (Grundgeiger and Sanderson, 2009; Sanderson and Grundgeiger, 2015; Raban and Westbrook, 2013).

The majority of ‘causal studies’ used statistical analysis methods where appropriate, to determine the significance of results. Some of the techniques used by researchers however make assumptions regarding sampling (e.g. the use of probability sampling) which were not clearly met.

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<sup>6</sup> Three studies reviewed in subsequent sections also considered positive effects of interruptions (Hedberg and Larsson, 2004; Klemets and Evjemo, 2014; Rivera, 2014). Two further studies included in the ‘counting and categorising’ section involved similar subjective coding of positive/ negative outcomes (McGillis Hall et al., 2010a; McGillis Hall et al., 2010b). Such coding however was only performed on a subset of the data in those studies, and hence it was not appropriate to review them in the current section.

### **2.3.1.3 Intervention Studies**

Intervention studies investigate the impact of measures designed to reduce interruptions, and/ or to improve care in some respect. Table 2-9 describes the settings, participants, interventions, research design, methods, and key findings of the 17 intervention studies included in the review. (Since only three intervention studies were published prior to 2009, these are also included in Table 2-9.)

One of the most striking aspects of intervention studies is how few of them are based on evidence regarding the deleterious effects of interruptions. Just six of the ‘before-and-after’ studies (Conrad et al., 2010; Fore et al., 2013; Freeman et al., 2013; Scott et al., 2010; Verweij et al., 2014; Weigl et al., 2014) examined the effects of interruptions prior to the intervention, and the majority had significant methodological shortcomings (described in detail, below). Other studies appear to have simply *assumed* that interruptions had adverse effects (Sanderson and Grundgeiger, 2015).

*Table 2-9 Key features of intervention studies*

First Author, Year, Country	Setting	Participants / sample	Study/ Intervention purpose (page no.)	Intervention description	Design/ Methods	Outcome Measures	Results
Bennett et al., 2006, US	Two 24-bed general medical units	Nurses were observed for four 12 hour shifts. Pharmacists observed for four 8 hour shifts	To compare a medication cart to a system using a medication cupboard, considering.. patient safety, efficiency. P36	Locked medication cupboard in each patient's room, to replace more traditional 'unit dose' medication trolley system	Before-and-after design/ structured observation, focus groups	Medication errors, missed doses, nurses' perception	Some benefits were observed with the new system e.g. nurses spent more time with patients, less time preparing and distributing medication and fewer interruptions during medication preparation and administration. Nurses and pharmacists preferred the new system
Catchpole et al., 2014, US	Level 1 trauma centre in US tertiary medical centre	Care received by 86 patients was observed pre-intervention and 120 post	To redesign the trauma process based on previously identified problems P963	Intervention included changes to equipment storage, medication packs, whiteboard, pre-briefing etc	Before-and-after design/ Structured observation	Interruption rate, treatment time, length of stay	More disruptions were observed post intervention when patients required a CT scan, or had received surgery. The effect of the total treatment time varied according to each aspect of the intervention. Length of stay was reduced for patients with major risk or mortality risk.
Colligan et al., 2012, US	Acute paediatric ward in an academic children's hospital	Too many methods to report sample size in a simple way	To decrease interruptions around a centrally located, medication station. P2	Various 'barriers' were constructed that protected the tasks likely to lead to errors if interrupted.	Before-and-after design/ Structured interview, observation	Interrupt rate, attitudes to medication station	Interruption rate was significantly reduced post intervention. Staff attitudes towards the medication station were also significantly improved.
Conrad et al., 2010 US	Progressive care unit in large non-profit community hospital	Unspecified number nurses. Number of medications observed also omitted.	To enhance safety and work efficiency by reducing nurse interruptions and creating a standard process. P138	Multi-faceted intervention. Included signs to warn others not to interrupt and education regarding the dangers of interruption.	Before-and-after design/ Questionnaire, structured observation	Interrupt rate, time per round, error rates	Number of interruptions reduced from mean of 4 per admin to 1 per admin. Admin time reduced by 1/3. Medication errors: decreased 1/5 in the 1st year, and more than 1/2 by the 3rd year. Questionnaire showed that the new medication process was considered more efficient and interruptions were thought to be reduced.
Craig et al., 2014, US	The following wards in a large hospital: medical-surgical, oncology, orthopaedic	Some 42 nurses from the participating wards were recruited.	To identify the most frequently interrupted tasks and to evaluate an intervention designed to reduce those. P3	White vest worn during administration stating: 'Please do not interrupt while passing medications'.	Quasi-experiment / Structured observation	Interrupt rate, duration, type	The number of medication interruptions was significantly reduced in the surgical and medical-surgical settings, but not the others. The most frequently interrupted tasks were questions by hospital staff, phone calls, and seeking supplies. Little change was observed in the type and duration of interruptions before and after the intervention

First Author, Year, Country	Setting	Participants / sample	Study/ Intervention purpose (page no.)	Intervention description	Design/ Methods	Outcome Measures	Results
Fore et al., 2013 US	A 30-bed medical/ oncology unit in a US hospital	Unstated number of staff volunteered.	To decrease interruptions and reduce errors. P106	Sterile cockpit principles. Involve the to elimination of all unnecessary interruptions	Before-and-after design/ Questionnaire	Self-reported number of interrupts, errors	A decrease in the mean number of distractions was observed after implementation of the sterile cockpit principles. The medication error rate was also reduced – more than 2/5.
Freeman et al., 2013, US	A cardiac and thoracic step-down unit in academic medical centre.	Medication preparation and admin observed for 59 patients pre-, and 40 post.	To reduce number of interruptions during medication admin – and the number of errors P176	Various changes, including education, development of a quiet zone, and tabard-vests	Before-and-after design/ Structured observation	Interrupt rate, medication errors	The mean number of interruptions per medication administration reduced from 3.3 to 2.1 over 3 months. Reported errors were also reduced, from 41 pre- to 13 post. The main 'causes' of interruption (patients and other nurses) similar before & after.
Kliger et al., 2012, US	Six hospitals and 11 pilot wards, plus 20 'spread units'	More than 2,000 drug admins observed pre-intervention, and more than 4,000 post-intervention	To develop a range of interventions to increase medication admin accuracy P51	Multiple interventions. Clinicians trained to lead organisational change projects. Not all interventions aimed to reduce interruptions	Before-and-after design/ Structured observation	Medication accuracy rates, number of admins free of interrupt	Medication accuracy rates increased from c.80% to c.98% across in the 11 pilot wards – and a similar degree in the 20 'spread' units. A higher proportion of both pilot and (especially) spread unit medication administrations were free of distractions and interruptions post intervention
Luketich et al., 2002, US	University of Pittsburgh medical centre operating room	Some 30 cases (operations) were observed, 15 in the intervention and 15 in the control group	It was expected that the intervention would save time for the circulating Nurse, and enhance surgeon satisfaction. P1266	HERMES Control Centre. Uses voice recognition to allow surgeon to control aspects of the operating room environment – including the surgical camera, lights etc.	Quasi experiment, with randomisation/ Structured observation	Time spent adjusting devices, surgeon and nurse satisfaction	Nurses were interrupted far less frequently with HERMES system. Interruption rates reduced from 15 per operation in the control to 0.3 in the treatment. The duration of nurses time spent handling interruptions was also reduced drastically. Both nurses and surgeons preferred the HERMES system.
Pape, 2003, US	Medical-surgical unit, large acute hospital in southern US	Some 72 of medication cycles observed.	To measure the effect of two interventions to decrease distraction P79	Checklists, vest tabards, measures to enhance teamwork – including education	Quasi-experiment. Tested two interventions	Number of observed distractions	Both of the interventions were effective in reducing nurse distractions. Results suggest that education, visual signage, and checklists are effective in reducing distractions.
Pape, 2013, US	Medical-surgical ward in US teaching hospital	Some 8 RNs were observed for a total of c.12 hours	To reduce interruptions, improve timeliness of medication and reduce omissions P211	Multiple interventions: vests, signs, quiet zone, checklist, teamwork, education	Before-and-after design/ Structured observation	Interruption rate, drug admin time, drug omissions	The intervention decreased nurse interruptions and distractions by 84% (i.e. when compared with the control group). The most common type of distractions and interruptions resulted from conversation

First Author, Year, Country	Setting	Participants / sample	Study/ Intervention purpose (page no.)	Intervention description	Design/ Methods	Outcome Measures	Results
Relihan et al., 2010 Ireland	Medical admissions unit in teaching hospital.	23 nurses observed pre- intervention and 14 post	To examine impact of intervention to reduce interruptions P1	Various changes, including signs to warn others not to interrupt, education, tabard-vests	Before-and-after design/ Structured observation	Interrupt rate, time per round	There was a significant reduction in the interruption rate post-intervention. Rates were reduced more than 50%. Differences were also observed in the sources of interruption after the intervention.
Scott et al., 2010 UK	The following three wards of a large acute teaching hospital: medical; cardiology; surgical urology	602 drug rounds (369 pre-intervention and 233 post). Questionnaires returned by 33 nurses, 39 other staff, 43 patients	To examine whether tabards reduced interruption and improved safety and care quality P1	Nurses wore tabard-vests during drugs round	Before-and-after design/ Questionnaire	Interrupt rate, occurrence of adverse events	The mean number of interruptions per round was significantly reduced after tabards were introduced. Average interruption frequency declined from 6 per hour to 5. The interruptions that did occur resulted from patients, missing drugs, ward nurses, phone calls and medical staff. Questionnaires indicated that nurses overwhelmingly supported use of tabards.
Tomietto et al., 2012, Italy	Seven surgical units in a teaching hospital located in northern Italy	56 medication rounds observed before and 56 after intervention. These were c.900 pre- and c.900 post-medication administrations	To reduce medication interruptions during medication rounds P335	Multi-intervention programme. Included Tabard-vests and education programme.	Before-and-after design/ Structured observation	Interrupt rate, durations	Interruption rates were reduced from one for every 3 medications given to one for every 2. The duration of interruptions post-intervention was also reduced by more than half (from c.11 minutes to c.5 minutes). In terms of sources, interruptions from patients became less frequent, but those from staff became <i>more</i> frequent (but shorter in duration).
Verweij et al., 2014 Netherlands	Three wards in a large university hospital: neurology, neurosurgery, a combined ward	All nurses on the three wards were observed (number not stated). Some 313 medication administrations were observed.	To reduce the number of interruptions experienced by nurses, and reduce drug admin errors P2	Implementation of tabard-vests during drugs rounds.	Before-and-after design/ Structured observation, nurse focus groups	Interrupt rate, medication admin errors, nurse perceptions	Significant reductions observed both in the number of interruptions and the frequency of medication administration errors after introduction of tabards. Nurses had mixed views regarding effectiveness of tabards.

First Author, Year, Country	Setting	Participants / sample	Study/ Intervention purpose (page no.)	Intervention description	Design/ Methods	Outcome Measures	Results
Weigl et al., 2014	2 paediatric inpatient wards of a University Children's Hospital.	28 full-shift observations at baseline, 11 observations at follow up. Close to 300 hours observation in total	To establish the effect of a documentation-assistant intervention. P637	Documentation assistants to help physicians complete paperwork	Controlled before-and-after design/ Structured observation, patient and physician questionnaires	Interrupt rate, paediatrician performance (self-rated), patients' care ratings	Interruptions decreased significantly after intervention in the treatment group. A reduction was also observed in the control group but this was smaller. Paediatricians reported enhanced productivity, quality, and efficiency at follow-up, while patients' care ratings also improved.
Weigl et al., 2012 Germany	Seven inpatient wards in hospital (including both surgical and internal wards). Intervention implemented on 4 wards (3 control wards)	20 full-shifts observed pre-intervention, and 20 post; Overall, 17 physicians participated in the observations. Physicians were also interviewed.	To reduce workflow interruptions by re-designing physicians' work P605	Intervention based on physician quality circles. Doctors helped to re-design their work.	Controlled quasi-experiment/ 2014 Structured observation, interviews Patient perceptions	Interrupt rate	Interruptions from other physicians and nurses were significantly reduced – although a decrease was also observed in control units. Interviews suggested that some intervention aspects were implemented in the control sites, meaning the control was 'corrupted'.

Developing and implementing interventions on the basis that interruptions *might* be disruptive, rather than on the basis of empirical evidence of this, could be problematic (Raban and Westbrook, 2013; Sanderson and Grundgeiger, 2015; Walter et al., 2015). Not only do researchers risk wasting energy in developing potentially *ineffective* interventions, they also risk undermining (rather than enhancing) desirable outcomes (Sanderson and Grundgeiger, 2015; Raban and Westbrook, 2013). If interruptions have positive, as well as negative, effects, attempting to eliminate these events might do more harm than good (Raban and Westbrook, 2013; Sanderson and Grundgeiger, 2015). While several studies focused on reducing ‘unhelpful’ interruptions (Conrad et al., 2010; Relihan et al., 2010; Fore et al., 2013), it was not clear exactly how this was determined (Raban and Westbrook, 2013).

Conducting empirical research prior to developing an intervention also has the advantage that the research findings can be used to inform the intervention design. Despite this, just two studies described how empirical findings were used in this way (Colligan et al., 2012; Catchpole et al., 2014).

Further criticisms of intervention studies relate to their design, and the methods used to evaluate the measures introduced. Four studies were described as quasi-experiments (Luketich et al., 2002; Pape, 2003; Weigl et al., 2014; Craig et al., 2014), while the rest employed before-and-after designs. Just four studies however included a control site (Pape, 2003; Luketich et al., 2002; Weigl et al., 2014; Weigl et al., 2012), despite the fact that this is crucial for causal inference (Raban and Westbrook, 2013).

Interventions were assessed in two main ways: 1) in terms of their effects on interruption rates; and 2) with regard to their impact on clinical outcomes (e.g. adverse events or perceived effects on clinical performance). While all studies examined the former, just seven considered the latter (Bennett et al., 2006; Scott et al., 2010; Fore et al., 2013; Freeman et al., 2013; Kliger et al., 2012; Verweij et al., 2014; Weigl et al., 2014). Most studies therefore provide only weak evidence of the clinical benefits of the interventions (Raban and Westbrook, 2013).

Another aspect of the design that might be questioned concerns the fact that all except three of the study interventions were multi-faceted (Scott et al., 2010, Verweij et al., 2014, Luketich et al., 2002); they typically involved the following three aspects: an education programme, 'do not interrupt' signs, and tabard-vests. While multi-measure interventions might enhance the chances of a 'positive' outcome (e.g. reduced interruptions or errors), it also makes it more difficult to determine which aspect produced any observed effects (Sanderson and Grundgeiger, 2015; Raban and Westbrook, 2013).

The duration of the treatment and the length of follow-up are important in any intervention study. Organisational change can be complex and it can take time for a new system to become established in a clinical environment (Craig et al., 2008). The effects of an intervention might not, therefore, be the same over the medium- or long-term (Craig et al., 2008; Raban and Westbrook, 2013). Unfortunately, the majority of studies ceased follow up measurements after four months or less (Pape, 2003; Freeman et al., 2013; Relihan et al., 2010; Verweij et al., 2014; Weigl et al., 2012; Colligan et al., 2012; Scott et al., 2010). Two studies did not report the length of follow-up clearly (Conrad et al., 2010; Craig et al., 2014).



In terms of methods, all studies except two (Scott et al., 2010; Fore et al., 2013) employed structured observations, together with counting and coding schemes, as the primary method. Of these, the majority depended on this method alone (Craig et al., 2014; Freeman et al., 2013; Relihan et al., 2010; Tomietto et al., 2012; Kliger et al., 2012; Pape, 2003; Pape, 2013; Catchpole et al., 2014). Relying on a single method is always problematic, and a more rounded view of the intervention could be seen in the studies that supplemented observation data with clinicians' feedback (Conrad et al., 2010; Colligan et al., 2012; Verweij et al., 2014; Weigl et al., 2014; Luketich et al., 2002; Bennett et al., 2006), or with patients' views (Weigl et al., 2014). Weigl et al., (2014) for example was able to establish that an observed reduction in interruptions post intervention was accompanied by an increase in doctors' self-reported productivity, and enhanced patient perceptions of care quality.

The use of subjective outcome measures in the above study (Weigl et al., 2014) might be criticised given individual biases that might effect performance perceptions. This study, however, did not rely on subjective measures to determine changes in interruption rates (before and after the intervention), as two other studies did (Scott et al., 2010; Fore et al., 2013). The challenges of remembering interruptions – which might be only very brief events – mean that such self-report data should be treated with great caution.

Just three studies involved a qualitative component (Bennett et al., 2006; Colligan et al., 2012; Verweij et al., 2014), and in each case this played a relatively minor role in the research. Greater use of qualitative methods might have facilitated deeper insights regarding the mechanisms underlying observed

effects, and helped to identify any unexpected consequences (Curry et al., 2009).

The shortcomings of researchers' counting and coding schemes were similar to those seen in previous sections. Few researchers described in detail how categories/ codes were defined or operationalised. Just nine studies in fact, defined interruption, let alone other interruption aspects (Bennett et al., 2006; Pape, 2003; Pape, 2013; Conrad et al., 2010; Tomietto et al., 2012; Weigl et al., 2014; Weigl et al., 2014; Craig et al., 2014; Verweij et al., 2014). Definitions, among those who provided them, were heterogeneous (Raban and Westbrook, 2013).

While all studies recorded interruption frequency rates, other outcomes were limited to a few types of error. The reliability of coding was adequately demonstrated (i.e. by computing and presenting a reliability statistic) in just five studies (Tomietto et al., 2012; Craig et al., 2014; Weigl et al., 2014; Weigl et al., 2014; Catchpole et al., 2014). More than 1/3 of studies (Conrad et al., 2010; Freeman et al., 2013; Kliger et al., 2012; Bennett et al., 2006; Fore et al., 2013) performed no statistical analysis.

The majority of studies included just one ward (Colligan et al., 2012; Conrad et al., 2010; Fore et al., 2013, Freeman et al., 2013, Relihan et al., 2010, Bennett et al., 2006, Luketich et al., 2002, Pape, 2003), and all but one (Kliger et al., 2012) was set in a single hospital. Convenience sampling was employed in all cases, and little attention was paid to the wider applicability of study findings.

#### **2.3.1.4 Interruption Handling Studies**

Interruption handling studies examine different strategies used by clinicians to manage interruptions. Table 2-10 describes the settings, participants, aims, methods, and key findings of the seven interruption handling studies.<sup>7</sup> (Since only three interruption handling studies were published prior to 2009, these are also included in Table 2-10.)

The study settings were extremely heterogeneous, with just two of the studies including comparable wards. The study by Drews (2007) was set in an intensive care unit (ICU), while one of the settings included by Collins et al., (2007) was in a medical ICU. Just two studies included multiple wards (Klemets and Evjemo, 2014; Collins et al., 2007) – and no studies included multiple settings (e.g. multiple hospitals).

Learning about interruption handling was not a main aim in three studies (i.e. this was studied as part of a wider research effort; Trbovich et al., 2013; Hillel and Vincente, 2003; Drews, 2007).

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<sup>7</sup> Note that four studies reviewed in the 'effects of interruptions' section (Palese et al., 2008; Savoldelli et al., 2010; Grundgeiger et al., 2010; Campbell et al., 2012), and one 'counting and categorising' study (See et al., 2014) reported data that could be considered in terms of interruption handling. The approaches used to collect and analyse data, and the findings reported by these studies however, were very similar to those reviewed in the current section, and the studies were not thought to add much to the discussion. Studies which did not meet the inclusion criteria also reported data regarding interruption handling (Brixey et al., 2007; Liu et al., 2009; Walter et al., 2013).

*Table 2-10 Key features of interruption handling studies*

First Author, Year, Country	Setting	Participants / sample	Aim/ purpose (page no.)	Methods	Results
Biron et al., 2009a, Canada	A medical patient care unit in a tertiary care teaching hospital in Quebec	Some 102 medication administration rounds were observed - with 18 nurse participants.	To document the rate, sources, secondary tasks, duration and strategies employed by nurses to manage (interruption) during medication administration P331	Structured observation	Interruptions occurred 6 times per hour on average. The need to deal with system failures (e.g. missing medication or equipment) or to coordinate care accounted for most interruptions during preparation. During administration however, patient tasks and self-interruptions were the most common reason. Interruptions lasted 1.5 minutes on the average most were handled immediately by nurses.
Colligan and Bass, 2012, US	Acute care paediatric in-patient setting	Observation details not specified. 14 nurse interviews in total. 6 different nurses participated in 'use cases'.	To understand how interruption management could support the design of interventions to reduce and mitigate related errors. P1	Interviews, structured observation, simulated medication 'use cases'	Four case studies of medication administration interruptions were presented, each illustrating the use of a different interruption strategy (immediate interruption, multitasking, deferring, rejecting). The findings suggested that nurses dynamically assess the primary and (interrupting) secondary tasks – and they prioritise tasks based on both risk and work efficiency assessments. Specific interruption handling decisions seemed to be motivated both task and experience related factors.
Klemets and Evjemo, 2014 Norway	Four units in a teaching hospital: Infection, Thorax, Geriatric, Orthopaedic.	Some 22 hours of observation was obtained. Number not specified.	To discover whether all interruptions by wireless phones are unwanted.. and to investigate how nurses handle these interruptions. P670	Interviews, unstructured observation, workshops with planned scenarios	Interruption handling decisions were stressful, and nurses had to maintain awareness of their colleagues' activities in order to assess whether they might need to respond to telephone interruptions. Nurses communicated extensively with one another to facilitate mutual awareness, and they prioritised their own workload in relation to their colleagues' availability.
Trbovich et al., 2013, Canada	Chemo day centre in a Canadian teaching hospital	A total of 38 shadowing sessions were conducted, with some oncologists being shadowed on several occasion	Examine the nature, frequency, and impact of interruptions on oncologists' ordering practices... and also interruption handling. P1	Structured observations	Oncologists spent close to 1/5 of their time handling interruptions. Many such events (interruptions) occurred during safety-critical medication ordering tasks. The main strategies used to handle interruptions involved immediate switching and multitasking. Other strategies, such as deferring and rejecting tasks were less common.
Collins et al., 2007, US	Medical ICU and medical/ surgical unit at a New York hospital	38 clinicians participated. 406 minutes of observation	Describes use of a taxonomy to analyse distractions and subsequent actions. P33	Structured observations	A total of 75 distractions were observed in just over 400 minutes of observation. Some 32 distractions were handled using (immediate) interruptions, while a further 30 were managed using multitasking. Some 5 tasks were left incomplete, and 4 recall failures were observed.

First Author, Year, Country	Setting	Participants / sample	Aim/ purpose (page no.)	Methods	Results
Hillel and Vincente, 2003 US	Post-Anaesthetic Care Unit at the Toronto General Hospital,	10 nurses were observed as they cared for patients. 25 hours observation recorded over several days.	When designing medical devices it is important to take into consideration the cognitive demands of the work environment. To this end, a field study was conducted P1	Structured observations	Most interruptions involved face to face communication with another clinician. The nurses returned, in all cases, to the primary task after interruption. All interruptions were handled using an immediate switching strategy. No adverse effects of interruptions on performance (e.g. in terms of errors) were observed – although some nurses became frustrated by the need to switch attention frequently.
Drews, 2007 US	Medical ICU at veterans hospital in Salt Lake City.	34 hours of observation conducted over two periods. More than 1100 activities observed Number of nurses not stated	To assess the frequency of interruptions in the ICU and the extent to which interruptions contribute to patient hazards. P2	Structured observations	Close to 1/3 of the 1100 or so nursing activities observed were interrupted. In 4/5 cases the nurse switched immediately to the interruption, while in 1/10 the interruption was rejected. In 1 in 20 cases the nurse multitasked. Delegating and 'other' strategies were used less often. Six adverse events were observed, and five of these preceded an interruption.

While currently few in number, interruption handling studies have made a significant contribution to knowledge of healthcare interruptions. By emphasising that clinicians actively manage interruptions, handling studies provide a more realistic framing of interruptions – and, in fact, a more sophisticated view of cause-and-effect. While the studies reviewed in previous sections mostly viewed the impact of interruptions in terms of a simple ‘stimulus-response’ relationship, implicit in handling studies is the notion that the effects of interruptions are likely mediated by clinicians’ handling of them. (Note however that this point was not explicitly made in any of the studies.)

The importance of interruption handling studies is further emphasised by the suggestion, made earlier, that interruptions might have positive, as well as negative effects – and therefore that their total elimination might not be desirable (Raban and Westbrook, 2013; Sanderson and Grundgeiger, 2015). If it is accepted that some level of interruption(s) might contribute to the safety and resilience of healthcare systems (Raban and Westbrook, 2013; Sanderson and Grundgeiger, 2015; Rivera, 2014), then greater emphasis might be placed on improving interruption management, rather than the eradication of these events.

A further, related, point concerns the potential benefits of studying how it is that interruptions are successfully managed in most situations. While healthcare researchers tend to study adverse events, it might be much more powerful, in terms of developing useful interventions, to study how such are events are successfully dealt with most of the time (as studying interruption handling would imply; Grundgeiger et al., 2010; Cooke et al., 2004).

Two broad ‘types’ of interruption handling studies could be identified: 1) quantitative studies which counted and categorised clinicians’ use of a narrow range of ‘fundamental’ (interruption handling) strategies – and which also examined the effects of these approaches (Trbovich et al., 2013; Hillel and Vincente, 2003; Drews, 2007; Biron et al., 2009a; Collins et al., 2007); and 2) qualitative studies which described more general aspects of interruption handling (Klemets and Evjemo, 2014; Colligan and Bass, 2012).

The quantitative interruption handling studies tend to imply that a limited range of options are available to clinicians when faced with interruptions (at least when viewed in terms of a chronology of the events/ behaviours that must happen subsequent to the interruption) – hence the term ‘fundamental’ (interruption handling) strategies. The specific strategies examined in these investigations include ‘immediate interruption’ (immediately attending to the secondary task and suspending the primary task), ‘multitasking’ (continuing the primary task while simultaneously performing the secondary one), ‘deferring’ (holding off for a period before switching to the secondary task), and ‘delegating’ (asking a colleague to perform the secondary task).

Table 2-11 shows that different researchers have examined a different mixture of ‘fundamental’ interruption handling strategies.<sup>8</sup> This heterogeneity, it might be argued, raises questions about just how fundamental the strategies are – or whose account of these is correct.

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<sup>8</sup> Researchers used slightly different terms to describe these strategies; those presented in Table 2-10 describes have been ‘standardised’ (i.e. by using consistent terminology) for ease of interpretation.

*Table 2-11 'Fundamental' interruption handling strategies examined in quantitative studies*

Trbovich et al., 2013: Immediate Interruption, Multitasking, Deferring, Rejecting
Hillel and Vincente, 2003: Immediate Interruption, Multitasking
Drews, 2007: Immediate Interruption, Multitasking, Delegating, 'Other'
Biron et al., 2009a: Immediate Interruption, Deferring
Collins et al., 2007: Immediate Interruption, Multitasking, Deferring, Rejecting

In terms of the frequency with which 'fundamental' strategies were used, Collins et al., (2007) and Trbovic et al., (2013) both found that immediate interruption and multitasking were used rather more than deferring and blocking, while Hillel and Vicente (2003) found that immediate interruption and multitasking were used equally often. Biron et al., (2009a) reported that nurses almost always immediately interrupted, while Drews (2007) also found that this occurred in the majority of cases. Rejecting tasks was next most common in the latter study, followed by multitasking and delegation.

Three studies examined the effects of interruptions in relation to clinicians' use of specific handling strategies (Hillel and Vincente, 2003; Collins et al., 2007; Drews, 2007). These studies should be praised since they directly examine the (potential) mediation effects alluded to above. That said, none of the studies described their analysis in terms of (looking for) mediation effects.

Hillel and Vicente (2003) found no obvious detrimental effects of interruption (and hence no mediating effects), nor did Drews (2007). Collins et al., (2007) found that deferral resulted in two incomplete tasks, while multitasking was associated with two cases of lack of recall. Immediate interruption was however, most likely to lead to errors, with three incomplete tasks, and two cases of lack of recall.



Criticisms regarding researchers' classification and coding schemes (in the context of counting and categorising interruptions, and interruption handling) made in other sections might also be directed at the quantitative interruption handling studies. Three studies failed to define interruption (Hillel and Vincente, 2003; Klemets and Evjemo, 2014; Colligan and Bass, 2012), and it was not clear how the different handling strategies were measured in most cases. It was also not obvious, as alluded to above, why some researchers examined only one or two strategies, while others examined four or five. If it is possible to 'multitask', 'defer', or to 'immediately interrupt', for example, then it would seem an omission not to include all of these. The lack of consistency and clarity in researchers' coding schemes made it difficult to meaningfully synthesise study findings – and it might also explain the apparent heterogeneity in the study results.

The two qualitative studies (Klemets and Evjemo, 2014; Colligan and Bass, 2012) described more general aspects of interruption handling, although the study by Colligan and Bass (2012) also presented case studies regarding the use of (four of) the 'fundamental strategies'. These two studies were also the only ones reviewed in this section to include more than one method. Both combined observations with interviews and/ or simulated 'scenarios'.

Colligan and Bass (2012) emphasised the importance of 'dynamic prioritising' (e.g. of primary and secondary tasks) in effective interruption management – including to support the use of the fundamental handling strategies. Such prioritising, it was suggested, was important not only to ensure patient safety, but also to increase the efficiency of clinical work. Specific 'efficient work strategies' included the use of 'rigid routines', where the order in which set of tasks is performed is established and familiar – making it easier to resume tasks if an

interruption occurs. Nurses also allowed interruptions more readily when current tasks provided cues for resumption (e.g. a medication 'cup' could remind nurses to get drugs) – or at least they claimed to do this – suggesting they use the environment to support remembering. (The study by Grundgeiger et al., 2010, reviewed in the 'interruption effects' section, reported similar findings.)

Klemets and Evjemo's (2014) study of nurses' handling of wireless-telephone interruptions showed interruptions can be very stressful to deal with. The study also revealed that nurses' awareness of their colleagues' activities played an important role in their interruption handling. The reason for this was that other nurses would likely take the call if they were not already performing an important or urgent task – but nurses had to remain alert to the possibility that they might be needed.

While only two qualitative 'interruption handling' studies were reviewed, these suggest considerable benefits might be derived from a qualitative approach. Both of the studies facilitated new discoveries regarding nurses' handling strategies (e.g. nurses' use of routines to support memory; the importance of nurses' maintaining awareness of colleagues), reflecting, perhaps, the more inductive approach typical of qualitative methodologies. Both studies also presented a richer, more holistic view of interruptions – and they suggested that the notion of 'interruption handling strategy' can be considered in broader terms than is suggested by studies of 'fundamental handling strategies' i.e. there may be many processes involved, including prioritising, considering how the clinical context might be used to support memory etc.

Little attention was paid in any of the studies to issues of sampling – and all studies had small sample sizes. The longest duration of observation, across all of the studies, was just 34 hours (Collins et al., 2007), while the largest number of participants (clinicians) was only 38 (Drews, 2007).

#### ***2.3.1.5 Studies of Healthcare Complexity***

The studies reviewed in this section examined interruptions as part of a wider investigation of healthcare complexity, and/ or how such complexity might be managed. It is worth noting however that several studies also shed light on interruption handling. Table 2-12 describes the study settings, participants, aims, methods, and results of the seven studies included. (Since only three healthcare complexity studies were published prior to 2009, these are also included in Table 2-12.)

Study settings were less heterogeneous than those seen for other study types. Three studies were conducted in a medical-surgical setting (Cornell et al., 2011; Redding and Robinson, 2009; Ebright et al., 2003), while three more took place on a general medical ward (Ebright et al., 2003, Hedberg and Larsson, 2004, Potter et al., 2005). All studies except two were conducted in multiple wards or departments (Rivera, 2014; Laxmisan et al., 2007). Most studies (four out of seven) were conducted in a single hospital or medical centre (Rivera, 2014; Laxmisan et al., 2007; Potter et al., 2005; Redding and Robinson, 2009).

Unlike the studies reviewed in other sections, healthcare complexity studies mostly adopted qualitative, or mixed (qualitative and quantitative), methodological approaches. All of the studies involved the use of observational

methods – and in all but one case (Redding and Robinson, 2009) these were unstructured or semi-structured. The majority of the studies (all except Cornell et al., 2011; and Redding and Robinson, 2009) combined observation data with data obtained from one other method – in most cases semi-structured interviews (Ebright et al., 2003, Laxmisan et al., 2007; Potter et al., 2005, Rivera, 2014).

*Table 2-12 Key features of healthcare complexity studies*

First Author, Year, Country	Setting	Participants / sample	Aim/ purpose (page no.)	Methods	Results
Cornell et al., 2011, Canada	Medical-surgical and paediatric oncology units in 2 US hospitals	Some 8 medical-surgical nurses and 11 paediatric oncology nurses were observed for 85 hours	To assess the cognitive impact of workflow on nurses. P407	Semi-structured observations	Nurses were interrupted very frequently, and they spent little more than one minute, on average, on each task. Few meaningful patterns were found in the workflow, or in the sequence/ order in which tasks were performed. The researchers concluded that nurses rarely had the opportunity for critical thinking.
Ebright et al., 2003, US	The following wards in 2 US hospitals: 4 medical-surgical, 2 medical, 1 recovery, and 1 orthopedic	8 experienced RNs were observed for 48 hours	To explore factors affecting registered nurse performance during real work on acute care medical-surgical unit P630	Unstructured Observations, Critical Decision Method Interviews	The demands made of nurses were dynamic and interruptions were thought to complicate nurses' task management. The nature of these events however was shaped, to a large degree, by where in (the specific area of the ward) the nurse was working. Nurses used a 'cognitive stack' – essentially a mental 'to do' list – to support their remembering of tasks – including tasks that had to be suspended or resumed (e.g. interruptions).
Hedberg and Larsson, 2004, Sweden	Three Swedish healthcare settings: medical ward, geriatric ward and primary care setting	8 RNs in total; 2 from a medical ward, 2 from a geriatric ward and 2 from a primary care setting asked to participate	To explore environmental elements related to the decision-making process in nursing practice. P316	Unstructured Observations, Content analysis	Nurses were frequently interrupted by other people and events, and interruptions were among the main factors found to effect nurses' decision-making. (The authors did not explain this point clearly). Such effects were not necessarily negative however; the authors noted that they could facilitate communication for example, regarding patients' conditions.
Laxmisan et al., 2007, US	Emergency department of a large tertiary care hospital	Emergency physicians, including residents and attending physicians. Sample size not clear	To characterise the factors that constrain safe decisions in patient care. Focus on the nature of interruptions, multitasking and shift change P802	Unstructured Observations, Semi-structured Interviews	The nature of interruptions experienced by attending physicians varied according to the source of the interruption – specifically whether the source was a medical resident or a nurse. Interruptions emanating from the former were fewer in number, but their duration was longer, compared to those coming from nurses. Interruptions placed a considerable burden on memory since clinicians had to recall what they were doing prior to interruption.
Potter et al., 2005, US	Nurses from the following wards in a US hospital: medicine, general surgery, orthopaedics, neuromedicine	7 RNs with varying experience levels	To analyse the nature of nurses' cognitive work and how environmental factors create disruptions that pose risks for medical errors P327	Unstructured observations, Semi-structured interviews	A large number of interruptions were observed, but many of these were related to nurses' current activities, and not all resulted in a 'cognitive shift' (a switch in nurses' reasoning processes). Interruptions often occurred during important tasks, such as medication preparation, but nurses prioritised tasks and the need to manage unplanned tasks was accepted as a normal part of the work. No evidence was found to suggest that interruptions were associated with errors.
Redding and Robinson, 2009, US	Some 6 medical-surgical wards in a large US tertiary care hospital	Some 32 staff nurses were observed for one hour each	To examine the type and frequency of work interruptions for nurses in medical-surgical hospital units P194	Structured observations, qualitative analysis of nurses' travel	Nurses were often distracted and interrupted as they travelled across the units, and they often had to pause briefly to reconsider the original purpose of their movements e.g. what did they want to pick up from the sluice before they were interrupted?

First Author, Year, Country	Setting	Participants / sample	Aim/ purpose (page no.)	Methods	Results
Rivera, 2014, US	Surgical Intensive Care Unit (ICU) in a US tertiary care hospital	5 expert nurses were observed for almost 16 hours.	To understand the cognitive processes underlying nurses' decision to interrupt other nurses. P2	Unstructured observations, Semi-structured interviews	The findings suggested that nurses conduct a rapid cost-benefit analysis to determine the appropriateness of interrupting other clinicians. Specific factors considered in relation to this included the nature of the interrupting task, as well as the potential implications of interruption – both positive and negative – for the interruptee and the interrupter (Rivera, 2014).

Like studies reviewed in previous sections, healthcare complexity studies suggest that clinical settings can be very dynamic, and health professionals have to manage frequent interruptions (Cornell et al., 2011; Potter et al., 2005; Laxmisan et al., 2007; Ebright et al., 2003). The real contribution made by these studies, however, concerns their highlighting various contextual factors – as well as aspects of cognition – involved in handling interruptions.

Specific contextual factors implicated in managing interruptions included *where* on the ward the nurse was working (Ebright et al., 2003; Redding and Robinson, 2009), the precise nature of the interrupting (secondary) task (Potter et al., 2005; Laxmisan et al., 2007), whether the interrupting task was related to the current activity (and hence whether it required the same, or different, thought processes; Potter et al., 2005), and whether the perspective of the interrupter or the interruptee was adopted (Rivera, 2014).

Regarding the role of cognition, almost all of the studies emphasised the difficulties imposed by interruptions on clinicians' memory (Cornell et al., 2011; Potter et al., 2005; Laxmisan et al., 2007; Ebright et al., 2003; Redding and Robinson, 2009), as many studies reviewed in other sections have. Unlike the latter however, complexity studies uniquely (or almost uniquely) emphasised the role of cognitive aspects such as managing (fragmented) attention (Cornell et al., 2011; Potter et al., 2005); prioritising tasks (Ebright et al., 2003; Potter et al., 2005; Laxmisan et al., 2007); conducting cost-benefit analyses (i.e. to consider the trade-offs of interrupting; Rivera, 2014); and considering the implications of interruptions from multiple viewpoints (Rivera, 2014).

Another finding, reported by several studies, was that interruptions were not necessarily considered negative events. Two studies for example found that interruptions were perceived as a normal and accepted part of clinical work (Potter et al., 2005; Laxmisan et al., 2007), while three others reported that interruptions had substantial benefits e.g. in terms of facilitating communication and supporting recovery from system failures (Hedberg and Larsson, 2004; Potter et al., 2005; Rivera, 2014).

The finding that the clinical context was crucial in determining the nature of interruptions might help to explain the heterogeneity of results reported by other types of interruptions studies (i.e. studies reviewed in previous sections). Such heterogeneity might imply that context is important – however it was difficult to establish this for certain given the reliance upon deductive counting and categorising approaches i.e. since diversity in the coding frameworks used by researchers, rather than variation the nature of interruptions occurring in different settings, might have accounted for the heterogeneity.

The highlighting in ‘complexity studies’ of cognitive processes implicated in interruption handling addresses earlier points regarding the value of investigating cognitive aspects of interruptions. It also underscores the point, made in the previous section, that the notion of an ‘interruption handling strategy’ can be considered in broader terms than is suggested by studies of ‘fundamental’ handling strategies. However, if a much wider range of cognitive processes is implicated in interruptions than is recognised in studies reviewed in previous sections, one is left to wonder how – and why – other studies have missed these.



The finding that interruptions were not necessarily negative events is consistent with studies reviewed in earlier sections (Berg et al., 2013; Savoldelli et al., 2010; Campbell et al., 2012; McGillis Hall et al., 2010a; McGillis-Hall et al., 2010), and it challenges the pervasive assumption that interruptions have negative effects. When considered alongside other study findings – regarding the role of context, and the importance of interruption handling, for example – it seems likely that effects of interruption will depend on the exact circumstances – and upon how these events are managed. It might further be added, in the light of the finding regarding their being multiple perspectives on interruptions, that there may simultaneously be costs and benefits, and that a holistic view may be obtained only by considering the trade-offs among these.

A final implication relates to research methodology. That these studies provided a broad and contextualised view of interruptions, and the complexities involved in their handling, might be attributed in part to their adopting a qualitative approach. As noted above, qualitative methodologies tend to be inductive and are thought to support the development of richer, more holistic accounts of phenomena than are quantitative approaches.

While helpful, the above studies leave a number of questions unanswered regarding the role of context. For example, why, exactly, were contextual factors considered by clinicians in their management of interruptions; what, if any, other contextual factors were considered in this process; what cognitive and/ or behavioural processes helped nurses to make use of contextual information?

Also, all of the ‘complexity studies’ were small in scale and sampling issues were given little attention. It is not clear what, if any, wider relevance the studies might

have. Just one study discussed in detail how rigour was established (Rivera, 2014), despite there existing a substantial literature on this (e.g. Mason, 1996; Lincoln and Guba, 1985; Patton, 2002). Greater use of cognitive research methods, such as cognitive task analysis approaches (Crandall et al., 2006; Hoffman and McNeese, 2009), might have proved helpful given that most studies emphasised aspects of cognition.

### **2.3.2 Summary of Main Findings**

The literature review highlighted considerable variety in the aims adopted by researchers, and how interruptions have been defined and conceptualised. Researchers appeared to disagree about key aspects of what interruptions are – for example whether interruptions are necessarily externally-imposed (as opposed to self-interruption). Nevertheless, it was possible to identify a traditional account of interruption to which many researchers subscribed. This suggests that interruptions involve the suspension of a current task in order to attend to an externally imposed unplanned task or event.

Five different types of interruptions study were identified, including counting and categorising studies, studies of interruption effects, intervention studies, interruption handling studies, and studies of healthcare complexity.

Counting and categorising studies aimed to describe the frequency, type and causes of interruptions. They employed structured observation methods, together with the use of coding schemes to record different aspects of interruption. Counting and categorising studies were distinguished from the other study types primarily by their aiming *only* to describe and quantify basic

interruption aspects – rather than *also* aiming to examine, for instance, interruption effects. The other study types also counted and categorised events, and made use of structured observations (with coding schemes) hence there was considerable overlap in the methods used by different study types. Methodological criticisms, which include an over reliance upon structured observations, weaknesses in coding schemes, and heterogeneity in the aspects of interruption reported by researchers, can therefore be directed at the literature as a whole.

Studies of interruptions' effects were rare, which is surprising given that most interruptions studies cite such effects (e.g. on safety) as the main rationale for the research. The types of effects examined by these studies varied greatly – although it was assumed in most cases that the effects would be negative. Finally, the way that interruptions effects were thought to come about (that is, the view of causality adopted) was simplistic in most cases.

Intervention studies aimed to reduce the number and frequency of interruptions experienced by clinicians – yet they merely assumed, in most cases, that interruptions were problematic (i.e. few interventions were developed on this basis of empirical evidence regarding deleterious effects of interruption).

Studies of interruption handling emphasised that clinicians actively manage interruptions, which provides a more realistic framing of the phenomenon. However, the 'fundamental handling strategies' examined by these studies represent only a limited range of possible ways of managing interruptions.

Studies of healthcare complexity examined interruptions as part of a wider investigation (of complexity). While these studies were few in number, they were more likely to adopt qualitative approaches, and they identified important findings regarding the role of context, and the use of various strategies (e.g. prioritising), for managing interruptions.

## **2.4 OVERALL AIM AND OBJECTIVES**

Based on the findings of the review, an overall aim for the study was set as follows.

*To understand the nature of interruptions occurring in dynamic clinical settings,  
and to better appreciate the role of clinical context in shaping nurses' handling of  
these events, alongside their other responsibilities.*

Key objectives of the study were to:

- Develop a conceptual framework to describe the nature of interruptions
- Examine specific strategies used by nurses to manage interruptions in the context of their wider responsibilities

The aim reflected key findings from the review regarding the importance of the clinical context, and the potential benefits of studying interruption handling.

The intention to develop a conceptual framework reflected the perceived need, highlighted in the review, for an improved, shared understanding of interruption, based on empirical observation. The reason for examining strategies to manage interruptions was that this might provide insights regarding, for example, how clinicians might better manage their workloads and reduce vulnerability to errors.

# **Chapter 3 Research Design and General Method**

This chapter describes the research design employed by the current study, together with an overview of the methodology. The study comprises two distinct research phases, each of which can be regarded as a discrete investigation, i.e. since each has its own aims, method section, results and discussion. The goal of the current chapter is to outline the intellectual framework within which these two investigations sit – and to describe common aspects of the study methods, i.e. so as to avoid repetition within each of the separate method sections.

## **3.1 RESEARCH DESIGN**

The majority of treatments of research design tend to distinguish two main aspects: 1) paradigmatic assumptions (i.e. epistemology, philosophical perspective, and methodology), and 2) research methods (Bryman, 2012b). These two aspects are thought to have a hierarchical relationship, meaning that choices regarding paradigmatic assumptions are seen to shape the choice of methods (Crotty, 1998; Gray, 2009, p19).

### **3.1.1 Paradigmatic Assumptions (epistemology, philosophy and methodology)**

Key epistemological and philosophical assumptions relate to issues such as ‘what constitutes useful knowledge for learning about the social world?’, ‘how can behaviour and society be studied’, and is there a single ‘reality’ beyond the

perceptions of individuals (Crotty 1998; Creswell, 2003; Bryman, 2012b).<sup>9</sup> Methodological assumptions relate to how the research aims might be met given the philosophical stance (Crotty, 1998; Creswell, 2003; Bryman, 2012b).

The choice of paradigms is usually presented in terms of a dichotomy between a positivist stance with a quantitative methodology on the one hand, or an interpretivist position with a qualitative methodology on the other (Mason, 1996; Creswell, 2003; Bowling, 2009; Gilbert, 2008, p135).

### ***3.1.1.1 Positivist-Quantitative Approaches***

Positivism suggests that human behaviour can be studied in the same way as the natural world (Bryman, 2012b; Creswell, 2003; Bowling, 2009). Studying people is not fundamentally different to studying atoms, and the goal of social science should be to identify the 'universal laws' that govern people's behaviour (Bryman, 2012b; Fulcher and Scott, 2007). Knowledge is developed by testing theories regarding the nature of such 'social laws' (Bryman, 2012b; Fulcher and Scott, 2007), implying a deductive research approach (i.e. since the researcher has a clear notion of what she is looking for from the outset).

Knowing what one 'is looking for' does not produce bias since researchers can 'stand apart' from a social situation, and view it objectively (Bryman, 2012b; Gray, 2009; Creswell, 2003). Positivists believe that there exists a 'reality'

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<sup>9</sup> The latter question, and researcher's particular view on it, is often referred to as 'ontological perspective'. While many regard ontology as distinct from epistemology, and examine the two issues separately, Crotty (1998) points out that they are closely related and inform one another. For this reason, I do not distinguish epistemology and ontology in the current treatment of these matters.

outside of, and external to, individual perceptions, and the role of the researcher is to 'shine a light on the true nature of things' (Fulcher and Scott, 2007; Gray, 2009; Creswell, 2003). Individual 'social actors' (those involved in the situation being studied) are not capable of this, since being 'socially involved' produces bias (Bryman, 2012b).

The deductive 'positivist' approach lends itself to quantitative methodologies (Fulcher and Scott, 2007; Creswell, 2003). Because behaviours of interest are specified from the outset, they can be measured precisely, and research can proceed in a structured manner (Bryman, 2012b; Bowling, 2009). Cause-and-effect can be quantified to better enable generalisation vis-à-vis 'social laws'.

### ***3.1.1.2 Interpretivist-Qualitative Approaches***

If interpretivism opposes positivism that is likely because it was developed in response to the latter's shortcomings (O'Reilly, 2013; Bryman, 2012b). People, it is argued, are different to atoms in that they interpret events, and other people's behaviours, and they modify their own actions accordingly (Bryman, 2012b; Creswell, 2003; Bowling, 2009). The complexity of social life mean that attempts to identify universal laws are misplaced (Crotty, 1998; Creswell, 2003; Denzin and Lincoln, 2005). Instead, the goal of research should be to understand how individuals interpret events and make sense of their lives (Fulcher and Scott, 2007; Creswell, 2003; Charmaz, 2006).

Interpretivists believe that the social world is comprised of multiple perspectives, and they reject the notion that there exists an 'objective reality' that can be uncovered by an impartial observer (Bryman, 2012b; Bowling, 2009; Denzin and

Lincoln, 2005). The positivist tendency to privilege the perspective of the 'objective' researcher is therefore abandoned in favour of an exercise in 'co-creation'. This recognises that researchers' attempts to represent others' lives will reflect both their own prejudices and those of their subjects (Mason, 1996; Charmaz, 2006; Bryman, 2012b).

Interpretivist assumptions can be observed in qualitative research approaches since the latter tend to be concerned with representing social complexity, and highlighting the role of context (Gray, 2009; Bowling, 2009; Mason, 1996). They provide a more holistic view than quantitative approaches – which are more concerned with precision (Bowling, 2009; Creswell, 2003).

Also, because the perspective of social actors is dynamic and amorphous, qualitative methodologies tend to be more inductive and flexible (i.e. compared with more structured and deductive quantitative approaches; Fulcher and Scott, 2007; Bryman, 2012b).

While the choice of research paradigms is usually described with regards a positivist-quantitative versus interpretivist-qualitative dichotomy, two main objections to this can be raised. First, the philosophical positions captured by the terms 'positivism' and 'interpretivism' represent crude caricatures, and they do not reflect the full range of approaches to social research (Gilbert, 2008; Mason, 1996; Tashakkori and Teddlie, 2003). Second, the idea that methodological choices are *determined* by researchers' philosophical stance represents a huge oversimplification (Bryman, 2012b; Denzin and Lincoln, 2005).



Regarding the first point, a variety of evidence suggests that researchers' philosophies are not as different as the above account would suggest (Hanson, 2008; Feilzer, 2010; Tashakkori and Teddlie, 2003; Bryman, 2012b). Examples can be seen in the healthcare interruptions literature, where, some authors (e.g. Colligan and Bass, 2012) draw on accounts of individual experience to support the making of general observations ('social laws'). Several ostensibly 'positivist' researchers, moreover, consider as evidence, data obtained from clinicians about their experiences of interruption (e.g. Baethge and Rigotti, 2013; Elfering et al., 2014), while 'interpretivists' oppose the notion that clinician data can be relied upon *on its own* (e.g. Berg et al., 2013; Ebright et al., 2003).

The second argument, that methodological choices are *determined* by researchers' philosophical stance, is undermined by the point, alluded to above, that qualitative approaches are sometimes used in the context of more positivist research (e.g. in studies that are guided by theory and/ or which are broadly deductive), while interpretivists sometimes draw on quantitative techniques (Bryman, 2012b; Denzin and Lincoln, 2005). Good examples of the latter in the healthcare interruptions literature relate to the finding (from the Literature Review in Chapter 2) that the vast majority of studies in this area have relied upon real-world observations – a method more closely associated with qualitative approaches.<sup>10</sup> Furthermore, a number of studies employed 'mixed methods' approaches that combine qualitative and quantitative methodologies (e.g. Potter et al., 2005; Wolf et al., 2006; Campbell et al., 2012; Colligan et al., 2012; Laxmisan et al., 2007). (The term 'mixed methods' is a misnomer since the

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<sup>10</sup> To qualify this point, it should be noted that most researchers' observations are highly structured, and the vast majority make use of event- and behaviour-coding schemes, more typically associated with quantitative approaches.

compatibility of different research approaches concerning their philosophical underpinnings is an issue of ‘methodology’ and not ‘method’; Bryman, 2012b.)

Mixed methods research is becoming popular in healthcare research (Freshwater, 2006; Bowling, 2009; Mason, 1996) – but if researchers can successfully combine qualitative and quantitative methodologies in a single research design this further undermines the notion that they are incompatible (Tashakkori and Teddlie, 2003; Denzin and Lincoln, 2003).<sup>11</sup>

### ***3.1.1.3 Pragmatism and Mixed Methods Research: A Third Approach***

The above examples suggest that many research methods might not have an intrinsic philosophical position – and nor might they be easily distinguished in terms of a quantitative-qualitative dichotomy (Hanson, 2008; Bryman, 2012b; Gilbert, 2008; Denzin and Lincoln, 2005). They also imply that researchers might be advised to design their research with reference to what they are trying to learn about as much as any philosophical assumptions (i.e. since methodologies have different strengths and weaknesses, depending on what one wants to know – and since the supposed ‘differences’ between them do not appear to be so fundamental). This ‘pragmatic’ approach – which involves a rejection of the simple paradigmatic dichotomy described above – might be considered a ‘third paradigm’ (Feilzer, 2010; Gray, 2009, p28; Creswell and Plano Clark, 2007).

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<sup>11</sup> One explanation for the (ostensible) failure of the positivist-quantitative versus interpretivist-qualitative dichotomy to stand up to scrutiny includes the finding that natural scientists (i.e. positivists) do not always do what they claim they have done when describing their method (Gilbert and Mulkay, 1984) – and they might, in fact, appear more like interpretivists if they were completely transparent (Bryman, 2012b).

The history of 'pragmatism' can be traced back to the mid-nineteenth century (Rorty, 1991; Feilzer, 2010; Gray, 2009). What is important, according to pragmatists, is not whether a methodology accords with a particular ontological or epistemological stance, but whether it facilitates understanding of the research question(s) (Rorty, 1991; Feilzer, 2010; Tashakkori and Teddlie, 2003).

Pragmatism avoids debates about the nature of reality by asserting that research can examine either the one ('true') reality posited by positivists, or the multiple realities (i.e. the multiple views of 'social actors') distinguished by interpretivists (Feilzer, 2010; Creswell, 2003; Creswell and Plano Clark, 2007). The approach also advocates that the social world is comprised of different 'layers', some of which might be considered subjective, others objective, and others still, a mixture of the two (Feilzer, 2010; Tashakkori and Teddlie, 2003).

#### ***3.1.1.4 A Pragmatic, Mixed Methods Approach to Studying Healthcare Interruptions***

As implied above, this researcher believes that the choice of methodology for the current study should be decided with reference to pragmatism – or more specifically, by addressing the question 'what would be most useful?'. Given the discussion above, it was considered that a primarily qualitative approach, with a quantitative component, would be most appropriate. Utilising a qualitative approach, it was hoped, would better illuminate the role of context, and the nature of interruptions, as well as potentially facilitating new discoveries e.g. regarding how nurses handle interruptions, or how this might be affected by the clinical context (Gray, 2009; Bowling, 2009; Creswell, 2003; Bryman, 2012b).

The Literature Review suggested that the small number of qualitative studies of healthcare interruption that have been conducted thus far have managed to achieve these goals, further suggesting the appropriateness of such an approach.

The expected benefits of including a quantitative component in the research included the ability to quantify the type and duration of nursing tasks, and the specific strategies that were used by nurses to handle jobs. It was also considered that any quantitative element should be used in the latter part of the study, when a good basic understanding of the nature of the interruptions in the study settings has been developed. This approach, where qualitative research is used to develop a basic understanding, and quantitative methods are used to provide more detail and precision, is consistent with what Bryman (2006) described as a 'discover and confirm' strategy (although note that Phase Two employed mixed methods, and was an exploratory study in many respects).

## **3.2 GENERAL METHOD**

There was considerable overlap in the method used for both of the study research phases, hence it is possible to describe a 'general method'. Aspects of each study phase that were unique are described in the separate method section provided for each (see section 4.2, Phase One, and section 6.2, Phase Two).

### **3.2.1 Research Structure and Chronology**

The current study comprised two distinct, chronological phases, which built on one another and enabled an increasingly detailed understanding of clinicians'

handling of interruptions. The aim of Phase One was to describe the context of nurses' work, learn more about the nature of nurse interruptions, and explore how nurses handled these events, in the three clinical settings. The understanding developed in Phase One was then used to design a more detailed and focused investigation of interruptions (and related phenomena) in Phase Two. To be more specific, Phase Two examined nurses' handling of a discrete nursing task, that had been described in detail prior to the substantive data collection. This allowed detailed (mixed methods) data to be collected, in real time, regarding nurses' task management.

The study design accords with the analogy, developed by several researchers (Spradley, 1980; Hammersley and Atkinson, 1995) of research as a 'funnel' (i.e. where the research becomes increasingly focused over the course of the study). Researchers have noted that in many qualitative studies – especially those adopting multi-stage designs – one only discovers what the research is really 'about' in the latter stages (Hammersley and Atkinson, 1995). This is true to *some* degree of the current study, where the 'funnelling' process begins with the literature review, and continues throughout the study (e.g. as the understanding of interruptions in the study settings is continually refined, and the nature of the contribution becomes clearer).

### **3.2.2 Study Settings**

There were three study sites, located in two London hospitals. These were: 1) Accident and Emergency, 2) surgical ward, 3) chemotherapy centre. The two hospitals were large, academic teaching hospitals, run by a single NHS Trust.

The clinical settings were purposively sampled to provide variability on aspects of the ward environment, and work organisation, that might affect the incidence or the nature of interruptions. It was hoped by that selecting settings that differed regarding such aspects, it would be possible to obtain rich data that could illuminate the role of the clinical context in shaping the nature and handling of interruptions. The study settings were not designed to be representative (e.g. the surgical ward was not supposed to be representative of all surgical wards), as it was not intended that the results should be generalised, in some simple way, to other study sites. Rather, the intention was that the findings could contribute to the development of theory, which might (or might not) have wider applications. This approach is similar to what Yin (2009;1993) called theoretical generalisation – where the results from a study support, or undermine, a model of reality – but they do not necessarily generalise to a wider population (Yin, 2009;Yin, 1993).

Key aspects of the ward environment, and work organisation, upon which variability was sought included the shape and size of the ward, whether work was team-based, or not, the degree to which the work was perceived to be dynamic, or time-critical, and differences in the nature and type of patient conditions.

Given the researcher's lack of a healthcare background, assistance was sought from experienced clinicians (including those on the supervision team, and clinicians otherwise known to the researcher) regarding how the above criteria could be met. A shortlist of five different clinical settings (i.e. hospital wards/units) was generated and the researcher then visited these sites, and met with the ward managers in each, to determine their potential suitability (i.e. vis-à-vis the above criteria) – as well as the willingness of management to take part (all

agreed in principle). The three sites that appeared to provide the most variability on the specific criteria were then selected. Table 3-1 describes how the selected settings varied on the specified dimensions. (Note that these were initial expectations, and nothing more; one goal of the empirical research was to confirm the extent to which these assumptions might be true.)

*Table 3-1 Criteria used to inform selection of study settings*

<b>Selection criteria</b>	<b>Accident and Emergency</b>	<b>Surgical Ward</b>	<b>Chemotherapy Centre</b>
<b>Physical environment</b>	Larger than other settings, with 'racetrack' design	Organised around multiple patient bays, no open plan areas	Patients treated in chairs rather than beds
<b>Work organisation</b>	Involves intensive teamworking among a large and diverse team	Involves moderate levels of teamworking, among quite a large team	Relatively little teamworking among nurses giving chemotherapy
<b>Dynamism and time urgency</b>	Demands thought to be extremely dynamic, and highly time-critical	Demands moderately dynamic with some time-critical tasks	Relatively low dynamism as all treatments are planned in advance
<b>Patient conditions</b>	Patient conditions more diverse than in other settings – and more acute	Patient conditions moderately diverse (since patients have had different types of surgery – but all gastrointestinal surgery)	Some diversity in patient conditions, but all have cancer

A brief description of the three study settings is provided below. More detailed information about the sites can be found in Phase One.

The Accident and Emergency department provides emergency care to adults and children 24 hours a day.<sup>12</sup> In total there are 25 beds (4 resus, 16 majors, 5 minors), and 40 seats in the waiting room. Patients are brought in from all over London and the department aims to admit, transfer or discharge patients within four hours of their arrival, in line with a Department of Health (2001) directive. The department is just one of five London hospitals designated as a major trauma centre, meaning that it gets a relatively large number of trauma cases (e.g. three-five per day on average).

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<sup>12</sup> This study focused solely on the treatment of adults.

The surgical ward cares for patients who are undergoing upper and lower gastrointestinal (GI) surgery, as well as those having urology surgery (around 95% of patients are GI). Both elective and emergency patients are admitted, and the average length of stay in hospital is similar to other surgical specialties. There are 21 beds on the main ward, with four additional beds in the High Dependency Unit (HDU). The HDU provides level two care for postoperative patients (levels of critical care described by Department of Health, 2006). The unit admits patients who are stepping down from level three (i.e. intensive care) elsewhere in the hospital. Once patients are stable, they are usually moved to the main (surgical) ward. The ward has a mix of genders although the bays are not mixed.

The chemotherapy centre is an outpatient ward staffed by nurses, healthcare assistants and support staff. It provides short-duration chemotherapy treatment (i.e. drugs that can be administered in 8 hours or less) to patients with a range of different cancer types. Both male and female patients are treated, and the majority are on a 'two-day pathway' (where patient assessment and treatment are split over two days). Patients are assessed by an Oncologist and undergo tests on day one (in the oncology clinic located elsewhere in the hospital), and, pending satisfactory results, they receive chemotherapy treatment on day two (in the Day Centre). The chemotherapy centre was very reliant, given this system, on the oncology clinic to provide the necessary information (i.e. blood and other test results, doctors' prescriptions), and the pharmacy to make up patients' chemotherapy drugs. The latter are highly toxic and (chemically) unstable, and the pharmacy do not administer drugs until they receive confirmation from the oncology clinic. This meant that drugs were made up on a 'just in time' basis.



The chemotherapy centre has 18 treatment chairs, and one bed for patients unable to sit comfortably. A variety of different chemotherapy treatments are administered, as well as a number of oncology (or related) treatments including blood transfusions, antibody treatments (e.g. Trastuzumab/ Herceptin) and steroids.

### **3.2.3 Pilot Testing**

The methods used in each of the study phases were extensively pilot-tested before the research commenced. Specific details of the pilot testing conducted for each research phase – together with the findings of these exercises – are described in the method sections of each.

Observations obtained from pilot testing were disregarded in the final analysis, in both study phases, as the tools and methods were substantially revised on the basis of what was learned. Key insights from these sessions were not ‘lost’, since they informed the researcher’s perceptions of the events and behaviours that were subsequently seen (in observations) or discussed (in interviews) – and they therefore helped to shape the analysis.

Pilot interview data were included in the final analysis since revisions to the interview approach were generally minor – and because standardisation was not a requirement for this method.

### **3.2.4 Non Participant Shadowing Observations**

Non participant shadowing observations were used in both of the research phases, and these involved the researcher shadowing nurses (a different nurse in each session), as they went about their normal duties. The nature of the shadowing sessions in each phase was quite different, but they shared several common features. In each case the researcher kept a distance from the nurse when he/ she engaged in private conversation with a patient, and he did not go 'behind the curtain' when it was drawn by a clinician. In addition, the researcher took regular breaks during observation sessions, and he used these to make fieldnotes on a smartphone. The fieldnotes summarised emerging themes regarding the nature of interruptions, the role of context, and nurses' task handling, and they developed initial ideas for analysis. (Further detail regarding the use and content of fieldnotes is provided in the separate method section provided for each study phase). As with all other data, fieldnotes were downloaded to an encrypted disk drive immediately after observation sessions.

Nurses were sampled purposively, with individuals of differing experience levels included to afford an understanding of what, if any, role experience might play in handling interruptions. Nurse experience data were obtained from ward managers, and used to inform recruitment – but no specific experience criteria were set given the need to work with the available, consenting nurses.

Details regarding the times of day, and specific nursing activities, that were covered by the sample, are described in the separate method section provided for each phase – as is information regarding the study participants.

### **3.2.5 Semi-Structured Interviews**

Semi-structured interviews were used in both of the research phases – although the specific (interview) methods employed were quite different, and distinct topics were covered. Nevertheless, the Phase One and two interviews shared several features; they were conducted in private rooms, on hospital premises, where conversations could not be overheard. With participants' consent, interviews were audio-recorded using a smartphone. They were then transcribed, verbatim, ready for analysis.

Nurses were selected for interview based on several criteria relevant to the research questions. These included experience levels, showing an interest in the subject matter, or demonstrating the ability to reflect on, or articulate, issues regarding interruption handling and task management. Assessment of individuals on the latter (non experience) criteria was performed subjectively by the researcher, after he had spent some time with the individual during observations. (Observations preceded interviews in both research phases).

Phase one included interviews with ward managers, as well as with observed nurses, and the procedure for these deviated from that outlined above, in several respects. Full details are provided in the relevant section of the Phase One method.

### **3.2.6 Ethical Considerations and Procedures**

The key ethical considerations for the study included informed consent, ensuring that nurse participants understood their right to withdraw, the potential to disrupt nurses' work during data collection, confidentiality, anonymity and data security, and patient privacy. Consideration was also given to the actions that should be taken in the event that any serious errors or clinical negligence were observed or described by participants. A variety of measures were taken to ensure that prospective (nurse) participants could provide informed consent. Ethical approval was given by the King's College London Psychiatry, Nursing and Midwifery Research Ethics Committee (reference: PNM/11/12-79; 28th March 2013).

After agreeing access with the NHS Trust, introductory meetings were arranged with nurses on each ward. The researcher described, in these meetings, the study aims and proposed methods in detail. Any questions that nurses had were also answered at this point, and an information sheet reiterating exactly what would be asked of participants, and describing how they could withdraw from the study at any stage of the research, was also distributed at this time. The information sheet emphasised that participants could withdraw their historical data (i.e. data about nurses' work collected at an earlier time point) at any time, so long as they submitted their request before the specified cut-off date.

Further efforts were made to ensure informed consent, and to highlight the right to withdraw, when the researcher returned to speak again to nurses, and to (potentially) obtain their consent. Before returning however the researcher allowed one week to pass in order that nurses could properly consider their decision to participate (or not). Nurses were spoken to individually, or in small

groups, to ensure that they did not feel pressured or coerced in any way, and the researcher reiterated again what would be required of participants. Any further questions that they had were also answered and it was made clear that participation was entirely voluntary. Nurses who indicated a willingness to participate were then presented with a consent form, comprised of five different tick-boxes relating to different components of the research. The researcher talked through the key points on the consent form and then allowed nurses to make their decision, without attempting to persuade them. Those who agreed to take part were given one copy of their (signed) consent form, while the researcher also kept a copy.

The potential to disrupt nurses' work was discussed at length with clinical partners, and considerable effort was made to minimise any interference that might be caused by the researcher's presence. The researcher worked around the needs of patients and staff (e.g. by scheduling observations and interviews at a convenient time), and he suspended data collection when (on just two or three occasions) it appeared to interfere with care. Nurses were told, at the beginning of observations and interviews that they should feel free to raise any concerns they might have regarding the disruption of care by the research, and they were reminded that data collection could be terminated at any time.

The need to maintain the privacy and security of participant data was considered a top priority. Participants were given a unique ID number, which only the researcher could decode (using a list held on an encrypted computer), and no participant names or contact details were included on fieldnotes, interview notes or any other study materials. Any identifying information was also excluded from any analyses that were developed. To facilitate this, participants were asked for

their advice about what, if any, personal details might lead to their identification. All fieldnotes, interview transcripts, and other study materials were subsequently checked to ensure that all such information was removed.

In the process of observing nurses, clinicians' interactions with patients were inevitably observed on occasion. No patient information was recorded during the data collection, and hence no attempt was made to obtain individuals' (patients') consent. Nevertheless, a number of steps were taken to ensure that patient's privacy was not compromised in any way. First, patients were provided with an information sheet outlining key aspects of the study, and describing how patients could object to the researcher's presence, and have observations immediately suspended. Patients who could not read were asked if they would like the information sheet read out to them (providing they spoke English). Second, no intimate care procedures were observed and the researcher always stayed 'behind the curtain' when sensitive matters were being discussed. Third, the researcher stood back a little in any direct care situation in order to avoid overhearing personal information, and to allow the patient to object to the researcher's presence.

A procedure was agreed among all parties (including the research team and the clinical partners) for reporting serious errors, or any clinical negligence that was observed or reported, although no cases of either were identified.

### 3.2.7 Analysis

As noted above, both of the research phases employed qualitative methodologies, while only the second phase included a quantitative component. Given that this is part of a *general* method (one that describes what is common to *both study phases*), the current section focuses on qualitative analysis only. (Information regarding the mixed methods analysis conducted in Phase Two can be found in the method section of that study.)

Framework Analysis Method (FAM; Ritchie and Lewis, 2003; Ritchie and Spencer, 1994) was used to organise the qualitative data, and to help to build a thematic framework. FAM is a content analysis method and it facilitates transparent and systematic analysis, grounded in the raw data (Ritchie and Lewis, 2003; Ritchie and Spencer, 1994). It also allows the analysis of relationships among phenomena, and the development of explanatory accounts (Ritchie and Lewis, 2003).

Ritchie (1994) described five key stages of Framework Analysis Method: 1) familiarisation with the data, 2) identifying a thematic framework, 3) indexing sections of transcripts and fieldnotes, 4) charting the data, and 5) mapping recurrent themes.

To familiarise himself with the data the researcher had all transcripts and fieldnotes printed, and he read these several times. Initial themes (e.g. regarding for example the nature of interruptions that occurred, nurses' handling of these, or the role of clinical context) were recorded in a diary, together with reflexive notes, as the researcher read through the data. Codes were then added to

transcripts and fieldnotes, and frequently the initial themes were refined (e.g. some categories were merged, others were split out) while new ones were also added at this stage. The 'indexed' data were then charted in Microsoft Excel for Macintosh, 2011. Pencil and paper were used to identify recurrent themes, and 'concept maps', such as those described by Hoffman and colleagues (Crandall et al., 2006; Hoffman and Militello, 2009), were used to identify relationships between categories. This resulted in further refinements and amendments being made to the identified themes.

After analyses were conducted for each of the settings individually, the results were compared across settings. Stake's (2006) method for cross-case analysis was adapted to facilitate this.

The researcher began by reading through the data from each setting in a single 'sitting', before writing synopses (in bulletpoint form) to summarise the findings of each. Initial themes (i.e. pertinent issues that distinguished the settings – or in some cases, united them) were recorded in the above-mentioned diary, while thoughts regarding the researcher's role in shaping or 'biasing' the findings were also noted down (in the diary) during this stage.

A more systematic process of comparison then began as the synopses for each setting were contrasted, and the initial themes were further refined. (As with the analysis of individual settings, some categories were merged, others were split out, while new themes were also added.)



The process of writing up the analysis led to further amendments and refinements in the themes, while this process also aided the identification of appropriate means to represent the main findings.

### ***3.2.7.1 Analytic Rigour***

While the main processes involved in the qualitative analysis were outlined above, it is important to describe at a more general level, the measures that were taken to ensure analytic rigour.

A number of different accounts regarding how rigour might be established in qualitative research can be found (e.g. Mason, 1996; Lincoln and Guba, 1985; Barbour, 2001; Patton, 2002). There is some disagreement about what the 'optimal' analytic approach might be, although several criteria appear in most such accounts, and these can therefore be considered good practice. These criteria include transparency and systematisation, thick description, triangulation, and reflexivity. The benefits of each of these criteria, and the approach taken to ensure that they were met is described below.

Transparency and systematisation allows the reader to determine the appropriateness of any attributions or inferences made on the basis of qualitative data (Ritchie and Spencer, 1994; Ritchie and Lewis, 2003; Patton, 2002; Creswell, 2003). To support transparency, references to the source (e.g. fieldnotes or interview transcripts) of any qualitative data extract cited in this study are provided, together with an anonymised sample of the raw data (i.e. fieldnotes and interview transcripts are provided in appendices). This allows the reader to establish the original context of the data, and to determine the

appropriateness of any inferences that are made (albeit only a limited amount of data could be included).

As described earlier, the data were structured and organised using Framework Analysis Method (FAM), which allows the reader to trace how the thematic analysis was developed (Ritchie and Spencer, 1994; Ritchie and Lewis, 2003). The frameworks created (using FAM) to support qualitative analysis in each study phase are described in the relevant chapters, while short extracts from each of the frameworks are also included in the appendices.

The term ‘thick description’ was coined by Geertz (1973) to describe the rich and detailed rendering of a phenomenon – be these social settings, events or behaviours – using qualitative methods. The inclusion of such detail is considered an important aspect of rigour in qualitative research because it is thought to reflect individuals’ social realities – and also because they allow the researcher to develop the kind of holistic and contextualised view of a topic which is considered a key goal of qualitative research (Bryman, 2012b; Geertz, 1973; Mason, 1996).

Thick description was considered especially important in the current study given the desire to represent the context of nurses’ work (since this appears to play an important role in clinicians’ management of interruptions). It was also considered that context would be crucial to help researchers to determine the degree to which the study findings might be generalised – however this term is conceptualised. Those who advocate theoretical generalisation, for example, will require a detailed (‘thick’) description of the study findings to determine the degree to which they support extant theory, while those who argue for ‘empirical

generalisation' (i.e. where an attempt is made to apply findings obtained from one clinical setting to one or more other settings) will want to learn as much as possible about the study setting to establish its potential applicability to other clinical environments.

Thick description of the three clinical settings included in this study is provided in the first phase of the research – including an account of the physical environment, key work systems and process, and (non-identifying) information about the nurse participants. The first phase also provides a detailed description of the nature and type of interruptions that occurred in each study setting, since these differ from ward to ward.

Data presented in each of the two phases (e.g. regarding interruptions and the related clinical events that were examined) are, where possible, accompanied by an account of the immediate clinical circumstances that might have played a role in nurses' handling of events (i.e. interruptions and related occurrences), or their perceptions of these. The type of information included here related, for example, to the number of patients in the ward, the nature of patients' conditions (especially their acuity and apparent severity), the nurse's perceptions of her workload, where this was apparent (e.g. because the nurse had to ask for help from a colleague), and the ostensible emotional impact of the work (e.g. whether the nurse was visibly stressed, or whether she admitted to being tired etc). Details regarding the availability of colleagues to support the nurses' as they handled interruptions, as well as the accessibility of specific tools and equipment needed to complete key tasks, were also provided where this was useful.

Triangulation involves using multiple methods or sources of data to provide evidence about the events being studied (Patton, 2002; Creswell, 2003; Stake, 2006). If a particular attribution is supported by data obtained from multiple approaches, it is suggested, the researcher (and the reader) can be more confident in their interpretation (Patton, 2002; Creswell, 2003; Stake, 2006). Each of the study phases involved the use of observation and nurse interview data, while Phase Two also used information from other sources (e.g. ward manager interviews in Phase One, task analysis and a review of trust protocols and procedures in Phase Two). In Phase Two, furthermore, a mixture of qualitative and quantitative methodologies were used to illuminate the aims of that study.

Clinical partners in each of the study settings, and the doctoral supervision team, both provided feedback on the analysis of each study phase, to provide 'multiple perspectives' and support the appropriate interpretation of events. This was considered important given the researcher's lack of a background in healthcare. Further details of how different approaches were combined, and how data obtained from different sources were integrated (to support triangulation), can be found in the 'method' section for each of the relevant chapters.

Reflexivity refers to researchers' reflecting on their biases and being open about how these might have shaped their research (Bryman, 2012b; Creswell, 2007; Lincoln and Guba, 1985;). Among the key focuses of the reflexive approach developed for the current study concerns the researcher's academic and occupational background. The researcher is a work psychologist by background, without experience of working in healthcare. A number of implications of this were identified with regards the approach taken to the research.

First, the researcher was concerned that he might misinterpret or misunderstand events or behaviours (either those observed directly or those related by nurses during interviews) given his lack of a background in healthcare. It was expected that the researcher would not immediately understand the more technical aspects of nurse's work (e.g. he would not know why the nurse might use a particular technique to insert a cannula into a patient's arm – or why some drugs were administered orally and some intravenously etc) being examined. What had not been anticipated however was the difficulty of following the nurses' 'train of thought' (e.g. how they perceived and interpreted interruptions and related events), which, it soon became apparent, might be important, and which appeared to be easier for those more familiar with nurses' work. On the other hand, not having a background in healthcare was considered helpful in some ways since looking at an issue with 'fresh eyes' can facilitate discovery (e.g. because those who are very familiar with a setting tend to make assumptions and develop prejudices that seem to impair their ability to make new 'connections' and insights; Bazeley, 2013, p15).

Several steps were taken to minimise bias resulting from the misinterpretation of clinical events. Extensive feedback was obtained from clinical partners, and from the supervision team (which itself was comprised of former clinicians) on early analyses to check for potential misinterpretations or any misreading of events. Being exposed to the clinical environment, and learning from clinicians' feedback, helped the researcher to quickly become more confident in his understanding of events – including both technical and cognitive aspects of nurses' work. Nevertheless, feedback continued to be sought from the above-

mentioned sources, throughout all phases of the study, to provide greater confidence in the attributions and interpretations.

A second aspect of the researcher's background that was thought to influence the research related to methodology. Unlike other social sciences, psychology (or at least, academic psychology) has a positivist orientation and it tends to favour quantitative methodologies (Howitt and Cramer, 2011, p292). The researcher was thus quite familiar with quantitative approaches but was less aware of qualitative ones. The impact of this on the research was especially apparent at the beginning of the study, as the researcher attempted to conceive of the investigation in quantitative terms (e.g. efforts were made to conceptualise different aspects of interruption as independent or dependent variables, and spent some time considering how phenomena might be quantified). The researcher became more aware of this bias as time went on and, prompted by the supervision team, efforts were made to learn more about interpretivist and qualitative approaches. As described above, the study ultimately adopted a mixed methods approach, which was thought to provide a more holistic view. Other potential sources of bias identified through the reflexive process related to the framing of the main study aim, and concerns regarding confirmation- and confabulation-bias.

Confirmation bias concerns the tendency to seek 'evidence' that supports one's existing understanding (i.e. and thus to overlook evidence that might cast doubt on this) – while confabulation refers to an inclination to conflate one's memory of events with one's imagination of how they might have been – or with people's version(s) of events (Kahneman, 2011; Hirstein, 2009).

The first aspect of concern regarding confirmation bias related to the potential exacerbation of the 'framing problem' (i.e. the general tendency to look for 'confirmatory evidence' may be more likely when a problem is framed in a biased way from the outset). A second aspect however related to the later stages of the research (Phase Two), and more specifically to the researcher's focus on cognitive aspects of nurse's interruption handling. Having spent considerable time examining theories regarding these issues, the researcher was concerned that he might inappropriately look for (confirmatory) evidence of these e.g. by projecting his own expectations of how nurses might handle interruptions with what was actually seen, or what was reported by nurses. This concern extended not only to data collection, but also to the analysis where the researcher might, it was thought, inappropriately use data to support theoretical ideas.

The main reason for concerns regarding confabulation were similar to those of confirmation bias – the key difference being that while the latter related to the distortion of the researcher's *interpretation* of events, the latter concerned the potential 'corruption' of the researcher's *memory* of these. Another reason for the concern about confabulation however related to data obtained directly from nurses – for example during interviews. It appeared that some of nurses' answers (e.g. to general questions about their handling of interruptions) were sometimes affected by confabulation, and a sort of 'post-hoc rationalisation' of events.

Concerns about potential confirmation bias and confabulation during the analysis were handled in part through the keeping of a reflexive diary. As with the framing effects, it was felt that by being cognisant of the potential to find evidence when it

was 'not really there' would make the researcher more critical about the tendency to view data through a certain (biased) lens.

Finally, regarding confabulation on the part of nurses (e.g. during interviews when nurses were asked about their interruption handling), several measures were taken to deal with this. First, it was found that focusing on specific and recent behaviours, rather than discussing historic or generalised actions, helped to reduce the tendency to confabulate (this point is explained further in the Phase Two method section; see Crandall et al., 2006, chapter 5; Hoffman and McNeese, 2009, chapter 9;) Second, where the researcher had any doubt about potential confabulation in nurses' data, the raw data and/ or considerable contextual information, was presented in the analysis, in order that the reader might determine for themselves the appropriateness of any inferences that were made. (This also represents another example of transparency in the analysis.)



# Chapter 4 Phase One

## 4.1 INTRODUCTION

The aims and objectives for the thesis overall were stated in the Literature Review Chapter as follows.

*Aim: To understand the nature of interruptions occurring in dynamic clinical settings, and to better appreciate the role of clinical context in shaping nurses' handling of these events, alongside their other responsibilities.*

Key objectives were to:

- Develop a conceptual framework to describe the nature of interruptions
- Examine specific strategies used by nurses to manage interruptions in the context of their wider responsibilities

### 4.1.1 Aim of Phase One

Building on the findings of the Literature Review, and to address the overall aim of the thesis, the aim of Phase One was to describe the context of nurses' work, learn more about the nature of nurse interruptions, and explore how nurses handled these events, in the three clinical settings. Specific objectives of Phase One were to:

- Provide a detailed description of the clinical settings, and the nature of nurses' work, in those settings
- Describe in detail the nature of nurse interruptions

- Examine different strategies used by nurses to support the handling of interruptions

Phase One also aimed to lay the foundations for further phases of the research, to be completed as part of the doctoral study.

#### **4.1.2 Definition**

The definition of interruption employed in Phase One was developed on the basis of the pilot study findings (based on data from pilot observations). Observations suggested the existence of three distinct aspects of interruption, that were not causally related (meaning that the first aspect did not necessarily lead to the second; nor the second to the third). These included: 1) the act of switching from a primary task, before it was completed, to a secondary task; 2) the completion of the secondary task; and 3) resuming the primary task.

It was considered that distinguishing between these three aspects might lead to a more precise/ rigorous analysis of interruption (i.e. since there is less chance of conflating separate events) – hence ‘interruption’ was defined only in terms of the first aspect.

***Interruption:*** *the act of switching from a primary task, before it was completed, to a secondary task.*

When interruptions are defined in this way, it was also noted, no assumptions are made regarding their involving an unplanned task or event. These events were of interest to the researcher, however, and they were also examined in the

majority of extant studies of ‘interruption’ (see Literature Review Chapter). For this reason, it was necessary to provide a separate definition of unplanned tasks.

***Unplanned task:*** a task that a clinician is required to perform but which he was not aware of before the start of his work shift. Might include a task that was initially ‘planned’, but which had to be rearranged.

## 4.2 METHOD

Much of the Phase One method was described in the previous chapter. The current section therefore focuses on describing aspects of the method that were unique to this phase of the research.

### 4.2.1 Participants

Participants were registered nurses working in the three clinical settings described above. Nurses were sampled purposively, with individuals of differing experience levels included to afford an understanding of what, if any, role experience might play in handling interruptions (see Research Design and General Method Chapter for details regarding how this was done).

In A&E, 6 of the 8 nurses were female, and their ages ranged from 22 to 48, with a median of 28 years. In the surgical ward, 7 of the 8 nurses were female, with an age range of 24 to 59 (median 32). In the chemotherapy centre, 6 of the 8 nurses were female, with an age range of 21 to 56 (median 37). Regarding nurse experience, the median time since qualifying as a Registered Nurse was 3.25

years in A&E, 2.5 years in the surgical ward, and 7 years in the chemotherapy centre.

The sample also included nurses performing different roles (e.g. HDU and non HDU nurses were included in the surgical ward; both ‘majors’ and ‘minors’ nurses were included in A&E) – and covered work performed at different times of the day. The sampling was designed to maximise the breadth of what was seen, but the data were not intended to be ‘representative’.

The Phase One data collection is summarised in Table 4-1. Non participant shadowing sessions and interviews were conducted with a different nurse each time, while static observations involved observing whichever nurse(s) happened to be working in a fixed location.

*Table 4-1 Data collection for Phase One*

	<b>Surgical Ward</b>	<b>Accident &amp; Emergency</b>	<b>Day Chemo Centre</b>	<b>Total</b>
Static observation sessions (hours)	6 (16)	6 (17)	6 (15)	18 (48)
Non participant shadowing sessions (hours)	8 (45)	8 (44)	8 (43)	24 (132)
Semi-structured Interviews (hours)	3 (3)	3 (3)	3 (3)	9 (9)
Ward Manager Interviews (hours)	1 (1.6)	1 (1.6)	1 (1.8)	3 (5)

## 4.2.2 Tools and Measures

A smartphone (Apple iPhone 4, iOS 6) was used to make free-text notes regarding nurses’ task management (in real time) during static- and shadowing observation sessions. The Apple Notes application, a simple text editing tool, was used to record to facilitate this. (Further details regarding how the

smartphone was used is included in sections 4.2.3.2 and 4.2.3.3, which describe the observation procedure).

## **4.2.3 Procedure**

### ***4.2.3.1 Pilot Testing***

The piloting of the observation methods involved the researcher conducting two observation sessions (one involving static observations, and one involving shadowing), in each study setting, lasting one hour each. Notes were made regarding the usability of tools – especially the smartphone used to record qualitative notes – and the nature and quality of the data elicited. The findings showed that a lot of rich, descriptive data could be recorded on the smartphone, quite quickly, especially by using the smartphone’s predictive text functionality. In addition, the findings highlighted key challenges for obtaining high quality data, such as specific locations where it was more difficult to observe nurses (e.g. in smaller rooms), particular tasks that were harder to record (e.g. because the nurse spent only a small amount of time performing certain tasks), and times of day that were problematic (e.g. because little was happening, or because was very busy and hard to ‘keep up’ with events). All of this information was used to inform planning of the observation sessions, and appropriate amendments were made to the observation procedures (e.g. regarding the need to use predictive text).

Interviews were pilot-tested with one nurse in each study setting. A draft ‘interview schedule’ was developed, including a range of potential topics and specific questions, and notes were made regarding the nature and type of data that was elicited. The pilot interviews indicated the need for additions and

amendments to the interview schedule, for example, regarding the need to provide definitions of key terms (nurses were not certain of what was meant by 'interruption' or 'unplanned tasks'), the rewording of certain questions, and reducing the interview duration (i.e. by removing questions that generated less rich or useful data).

Other important findings of the pilot study related less to the study methods and more to the nature of interruptions. Numerous examples were observed, in all settings, of interrupted tasks not being resumed immediately after the secondary task – as well as some instances where the original activity (the primary task) was never resumed at all. In the chemotherapy centre, a nurse was interrupted while filling in a patient's allergy tag (a band worn around describing the patient's known allergies) by a question from a colleague. After helping her colleague (i.e. completing the secondary task) the nurse went to speak to the ward manager (i.e. she did not return immediately to the interrupted task), and only later resumed completing the patient's allergy tag. A similar example of a nurse switching to a task other than the primary task after interruption was observed in the context of an A&E patient assessment task. In the surgical ward, a nurse began rescheduling a patient's drugs – but she could not find a doctor to authorise this, so she switched to another (secondary) task, and she forgot entirely to resume the primary task.

Other examples of these behaviours could be given but the reader will likely appreciate the point being made – that several distinct aspects of interruption could be identified, and one aspect did not necessarily lead to another, as is often assumed by extant accounts of interruption. (This point can be verified by examining again the traditional account described in the literature review – or

other descriptions of interruption.) Just because an individual switched from a primary task, before it was completed, to a secondary task, did not mean that he/she necessarily had to: a) complete the secondary task; or b) resume the primary task immediately afterwards.

These findings suggested the need to be specific, in defining 'interruption', about which of these aspects constituted interruptions – as mentioned in the definition described in section 4.1.2.

#### **4.2.3.2 Static Observations**

Static observation sessions lasted between 2 and 3 hours each. The researcher stood in a set location – public places, where no private interactions could be seen or overheard – and he observed the work of consenting nurses. The locations for all static observation sessions are highlighted in the floorplans depicted in Figure 4-1 to Figure 4-4. More specifically, Figure 4-1 and Figure 4-2 show floorplans for Accident and Emergency, while Figure 4-3 and Figure 4-4 show floorplans for the Surgical and Chemotherapy wards respectively. Table 4-2 through Table 4-4 describe the number of beds in each area, as well as the number of nurses typically allocated to work there.

The sites were selected with assistance from ward managers, on the basis that they would provide exposure to a variety of different aspects of nurses' work – and also that they would facilitate understanding of the main functions performed by the ward. This allowed the researcher to develop an understanding of the clinical settings, and of the nurses' work, before the non participant shadowing observations, and the semi-structured interviews, began.

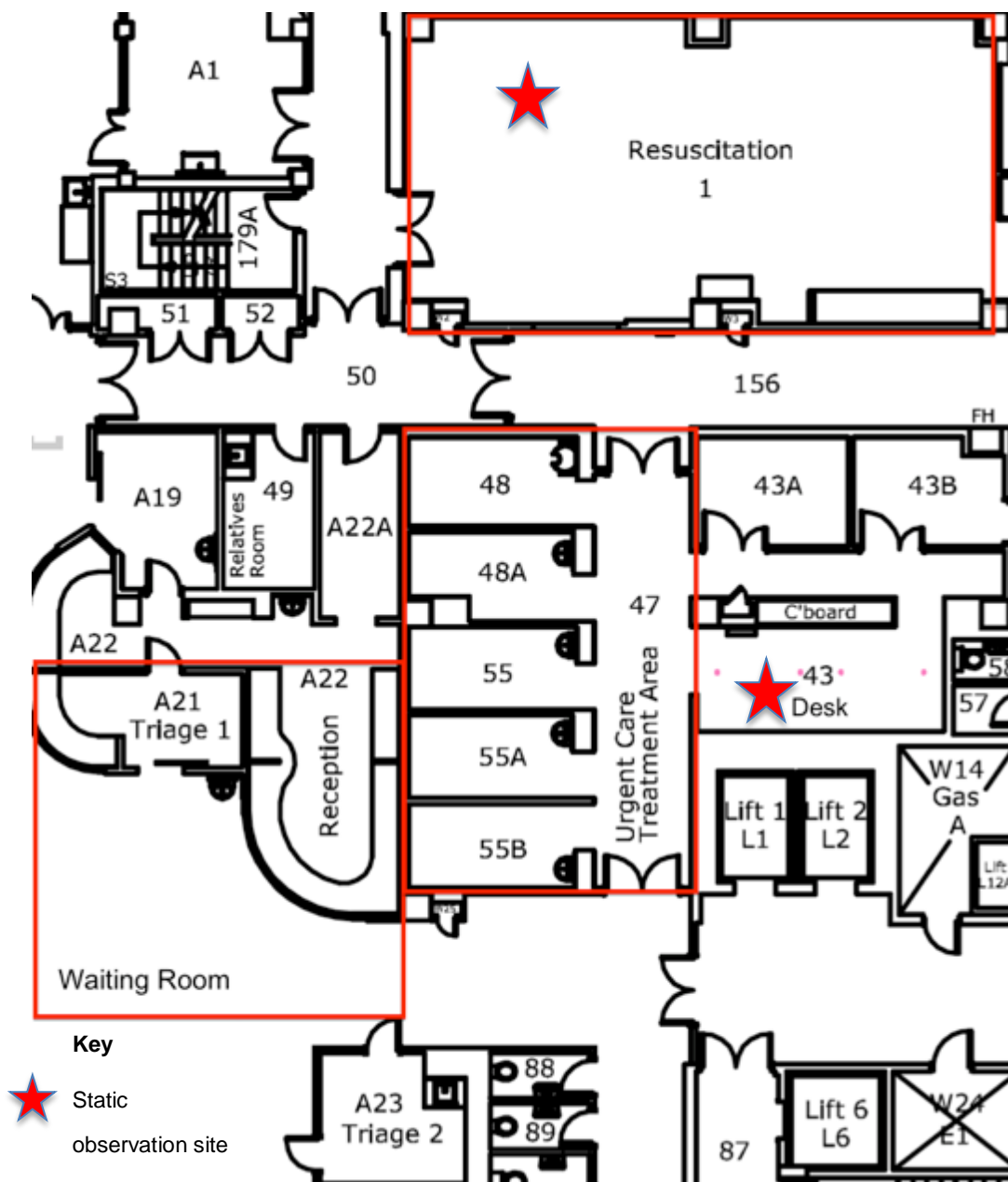


Figure 4-1 Accident & Emergency: reception, waiting room, resuscitation and minor treatments area (labelled "Urgent Care Treatment Centre")

Table 4-2 Accident & Emergency: beds and staffing

Ward Area	Beds	Nurses
Reception/ Waiting Room	40 seats	0
Resuscitation Room	4	2
Minor Treatments Area (labelled "Urgent Care Treatment Centre")	5	1
Major Treatments Area	16	4
Total	25	8



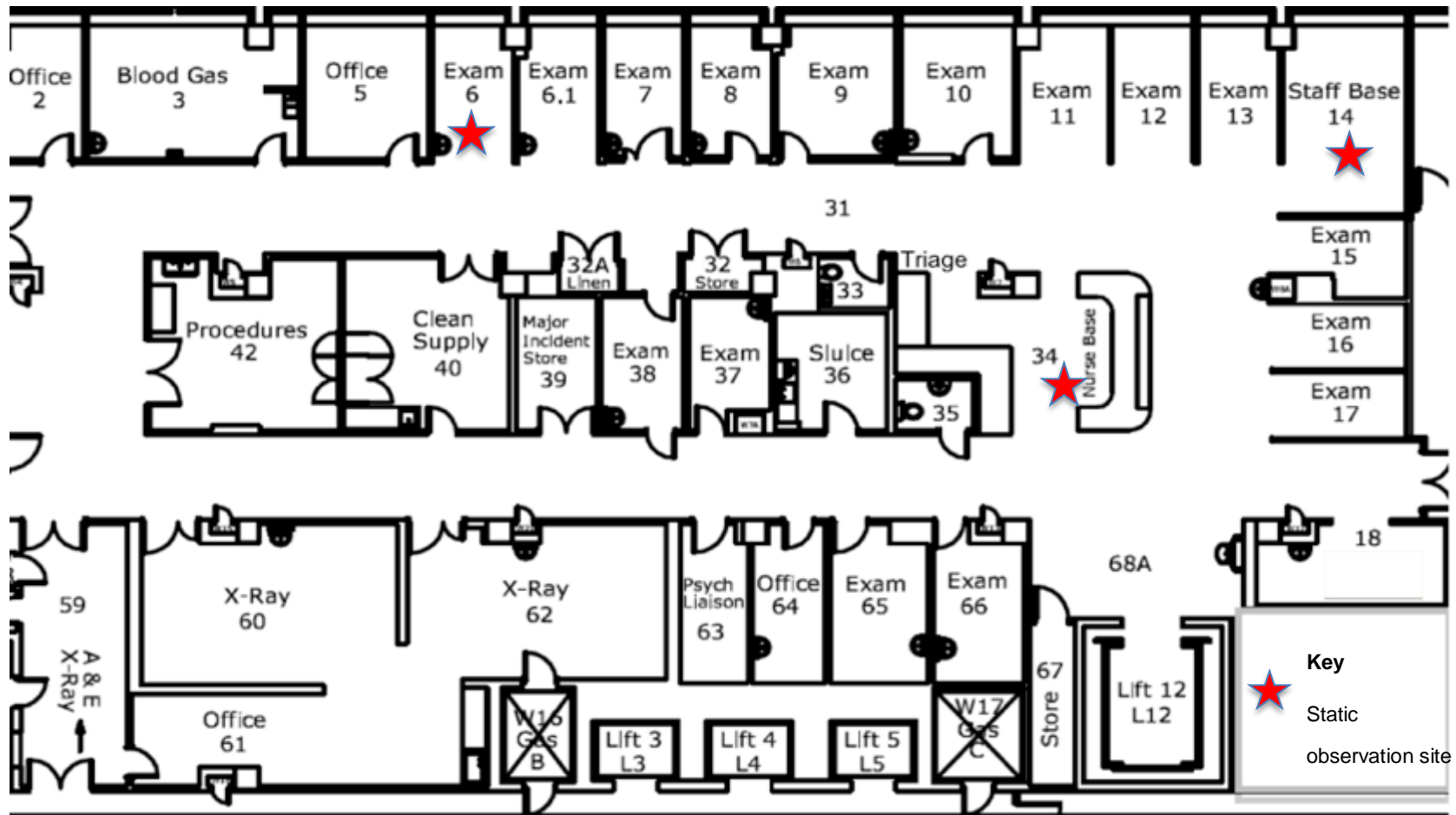


Figure 4-2 Floor plan of Accident and Emergency ward – major treatments area

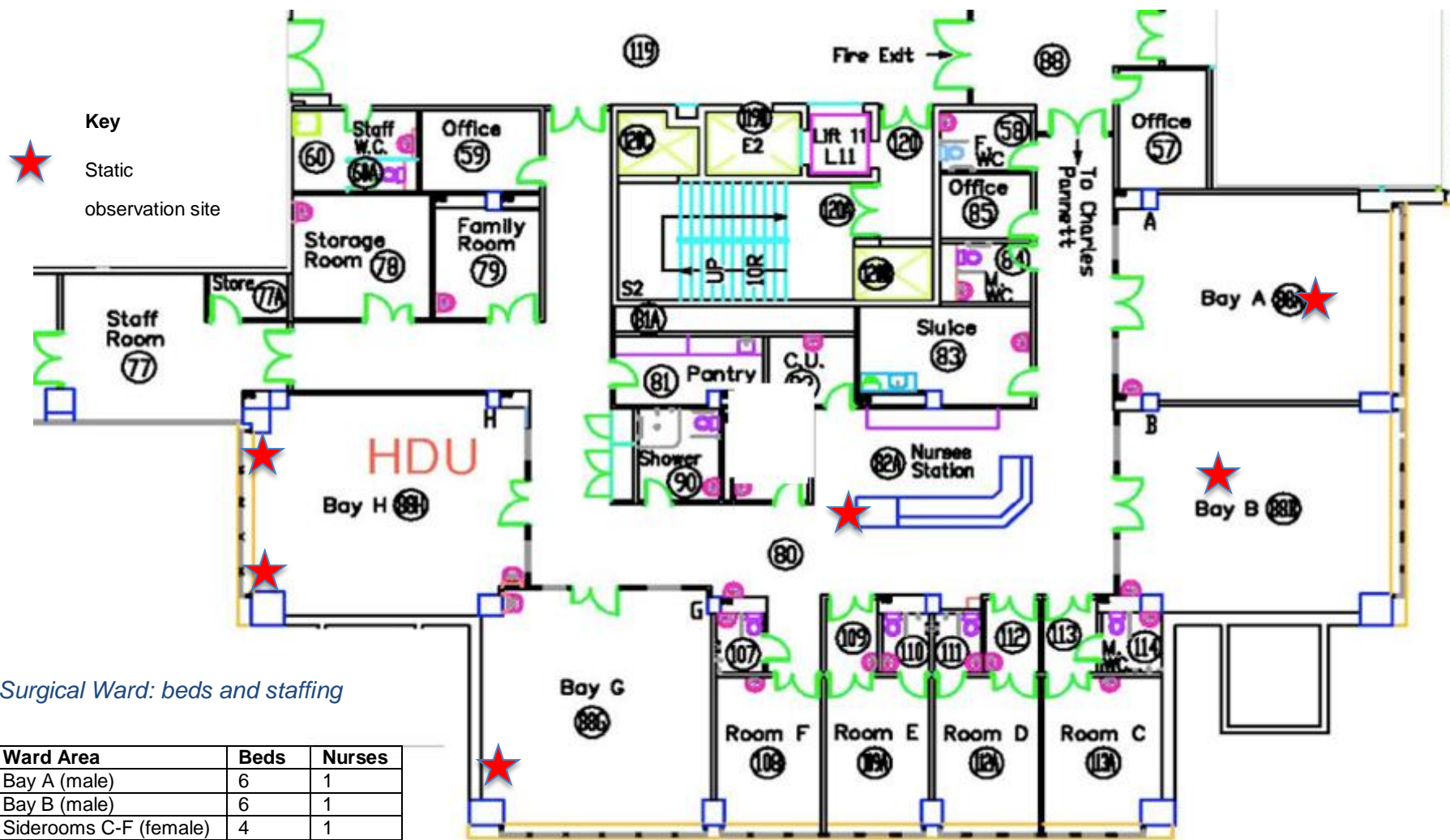


Table 4-3 Surgical Ward: beds and staffing

Ward Area	Beds	Nurses
Bay A (male)	6	1
Bay B (male)	6	1
Siderooms C-F (female)	4	1
Bay G (female)	5	1
HDU (mixed)	4	2
Total	25	6

Figure 4-3 Floor plan of surgical ward – including High Dependency Unit (HDU)

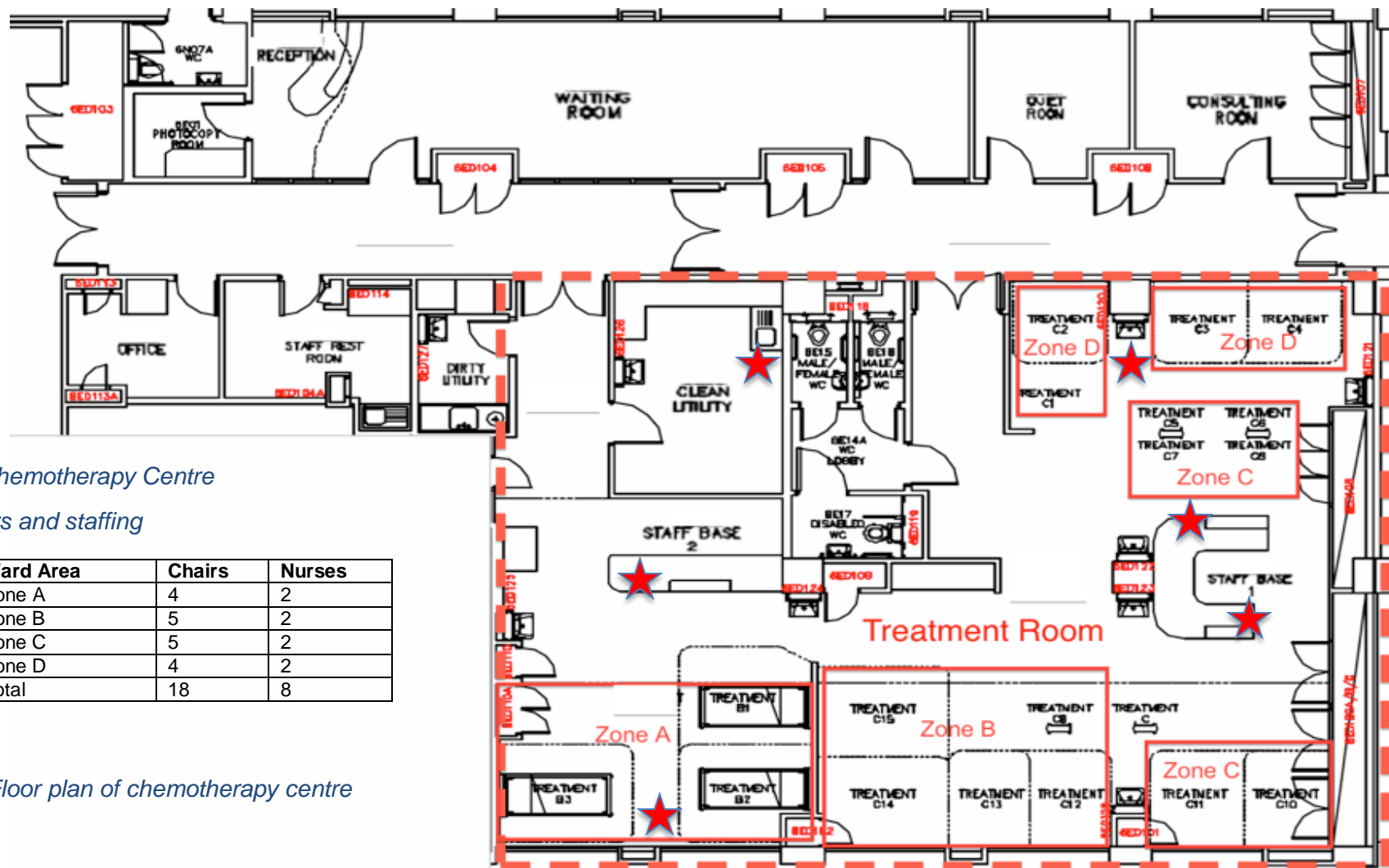


Table 4-4 Chemotherapy Centre  
zones, chairs and staffing

Ward Area	Chairs	Nurses
Zone A	4	2
Zone B	5	2
Zone C	5	2
Zone D	4	2
Total	18	8

Figure 4-4 Floor plan of chemotherapy centre

Detailed notes were recorded on the smartphone regarding the nature of interruptions that occurred, the types of tasks performed by nurses, and the particular clinicians involved. Details regarding the physical environment, the tools and technologies used, and aspects of work organisation (e.g. whether it was primarily team-based or individual) were also recorded – as was information regarding any ostensibly disruptive events.

#### ***4.2.3.3 Non Participant Shadowing Observations***

Non participant shadowing sessions (n=8 per setting) began after static observations were completed. The researcher shadowed a different nurse in each session as they went about their normal duties, for between 4.5 and 6 hours.

Nurses were asked during shadowing sessions, or shortly afterwards, to explain particular events or behaviours of interest. Most such queries related to the nature of the interruptions that occurred, and how these were handled by nurses (e.g. what was the reason for interruption; what were the main considerations in deciding to interrupt; why did the nurse interrupt some tasks but not others?). However, the researcher also asked about specific tasks that the nurse performed (e.g. what was the goal; what resources were required to complete the task?), and feedback was also sought regarding the role played by various aspects of the clinical context (e.g. tools and technologies used, the physical environment, etc.) At quiet times, nurses were invited to provide a running commentary of their thought processes vis-à-vis these issues. The aim was to provide rich data regarding the thought processes underlying nurses' behaviour and decision making, similar to that obtained using the Think Aloud method

(Schooler and Engstler-Schooler, 1990; Ericsson and Simon, 1993). (A crucial difference between Think Aloud and the approach used in the current study however concerned the lack of audio recording, and the subsequent production of a 'transcript'.) The researcher emphasised in such situations that nurses were not obliged to share their thoughts, and that they should not do this if it might interfere with patient care.

The researcher made detailed free-text notes throughout the sessions using the smartphone. Rich information about the nature of interruptions, the context of the work, and nurses' task management behaviours were recorded in real time (or as close as possible). The current time was recorded in the notes at regular intervals to provide an indication of the temporal flow of work (events were not automatically time-stamped). Nurses' answers to the questions described in the previous paragraph, as well as any data obtained through running commentaries, were also captured in the notes. The researcher took breaks where necessary to prevent fatigue and to maintain the quality of the data. Breaks were also used to make fieldnotes, which summarised emerging themes (e.g. regarding nurses' handling of interruptions, how this might have been affected by the clinical context) and helped to develop concepts for the analysis. Observation data were downloaded to an encrypted disk drive immediately after each session.

#### ***4.2.3.4 Semi-Structured Interviews***

Three of the eight shadowed nurses – including at least one experienced, and one inexperienced nurse – in each setting took part in semi-structured interviews. Interviews commenced after all observation sessions were completed, and they lasted one hour. They covered three broad areas: first, nurses were asked about

their backgrounds and their clinical experience, to provide some context for the interview. Second, nurses were asked about their perceptions of their work in general – including issues such as the nature of patients' conditions, how the work was organised (e.g. to what degree did it involve teamwork?), and particular tools and technologies required to complete key tasks. Third, nurses were asked about the nature of the interruptions and unplanned tasks that they faced. Specific questions related to common types of interruptions that occurred, why interruptions were required, and who or what tended to instigate them. Nurses were provided with a general definition of interruption, and a description of unplanned tasks (as per section 4.1.2), after the pilot study had indicated the need for these. The definitions were presented only as a guide; they were not assumed to be 'correct' or appropriate necessarily.

An interview schedule was developed to provide a structure for the discussion (see Appendix C). Some deviations from the schedule however were allowed when this was thought to be useful (e.g. because the nurse mentioned an issue that the researcher had not thought about, but which was particularly pertinent given the study aims; or because the researcher wanted to ask about specific events that occurred during observation sessions.)

## **4.3 ANALYSIS**

There were two distinct stages of analysis. The first stage involved developing a detailed description of the three study settings, and the nature of nurses' work within these settings (including the nature of interruptions that nurses had to deal with). The second stage involved comparing and contrasting the findings from each of the settings.

Framework Analysis Method (FAM; Ritchie and Lewis, 2003) was used to help develop the detailed description of study settings and nurses' work (including nurse interruptions), in the first stage of analysis. The approach used to do this was described in the Research Design and General Method Chapter (section 3.2.7). Extracts from the framework used to support the development of the detailed setting description can be found in Appendix E.

An adapted version of Stake's (2006) method was used to systematically compare and contrast the findings from different settings. As with FAM, details of Stake's (2006) method were described in the Research Design and General Method Chapter (section 3.2.7).

The analysis of individual settings (the first stage of analysis) identified ten main themes – key aspects of the study settings and of nurses' work (including interruptions). This was later reduced to seven themes since there was an unnecessary degree of 'overlap' – and hence duplication – between themes. The seven themes were: the layout and physical environment, nurses' travel and movements, key nursing tasks, tools and technologies, staffing and temporal aspects (including interruptions), communication, and teamwork. These themes are not presented in the main results section, below, because the analysis of *individual* settings were not considered crucial; the main findings were derived from the comparison between settings. However, the themes for each of the individual settings can be examined in Appendix F.

The comparison between settings (the second stage of analysis) identified 15 themes, but this was reduced to 10 main themes, with 7 subthemes. Reference is

made in a number of places in the main results section to analytic notes and fieldnotes that were used to support the analysis (see again the Research Design and General Method Chapter). Extensive raw data is also presented throughout.

To verify initial findings, and further develop the analysis, short ‘validation interviews’ were conducted with nurse managers on each ward. During the interviews, which were semi-structured and lasted around 90 minutes, the researcher described key results to the participant and asked for feedback. The interviews were audio recorded and transcribed ready for analysis.

## 4.4 RESULTS

Extensive reference is made below to the raw study data, including observation notes (qualitative data, recorded in real-time), fieldnotes (taken during breaks in observations), and nurse interviews. Appendix D contains an example of each of these, allowing the reader to see the original context of the data. References maintain a consistent format, as the examples in Table 4-5 show.

*Table 4-5 Format of references to raw data*

DC1INT 1,8 = chemotherapy centre, participant 1, interview transcript page 1, line 8
SU5STAT 2,11 = surgical ward, participant 3, static observation notes page 2, line 11
SU3SHA 3,21 = surgical ward, participant 3, shadowing observation notes page 3, line 21
AE3FN 1 = accident & emergency, participant 3, fieldnotes page 1



### 4.4.1 The Nature of Nurses' Work

Nurses' work was characterised by complexity and dynamism, and nurses had to manage many unplanned tasks and competing demands. Table 4-6 summarises five issues which contributed most to complexity and dynamism.

*Table 4-6 Five main sources of complexity and dynamism*

The need to:
<ul style="list-style-type: none"><li>• Access scarce resources e.g. other clinicians and key information (AE2FN 1; SU03FN 2; DC1FN 2)</li><li>• Coordinate resources in time and space (AE5FN 1; SU03FN 2; DC4FN 1)</li><li>• Manage specific task constraints e.g. skill and sequential requirements (AE4FN 1; SU2FN 2; DC6FN 3)</li><li>• To follow organisational policies e.g. clinical targets, protocols (AE2FN 1; SU2FN 1; DC4FN 1)</li><li>• Adapt to new and changing patient demands (AE4FN 1; SU1FN 2; DC6FN 1)</li></ul>

Surgical nurses' work was most complex and dynamic, followed by that of emergency, and then chemotherapy nurses (SU4FN 2; AE6FN 1; DC6FN 1). One might have expected emergency nursing to be most challenging since emergency nurses had no knowledge in advance of their shift regarding the patients they would have to care for – and because the need to look after acute patients was expected to present considerable demands. Surgical and chemotherapy nurses were given detailed information about their patients at the start of their shift, allowing them to plan the resources and equipment they might need, while patients in these settings tended to be slightly more stable on average when compared with those in A&E (SU4FN 2; SU2SHA 3,11; AE3STAT 4,6).

*It seems that a wide range of factors conspired to make surgical nurses' work extremely complex – and noticeably more so than A&E or chemotherapy [nurse's work].... [The researcher] expected A&E to be most complex/ dynamic, and with*

*most unplanned tasks, but it is really well resourced compared to surgical ward...  
they have lots more experienced nurses [compared to the surgical ward]... and  
there seems to be more routine work than expected [in A&E]. Analytic Notes p3*

*Many surgical patients were more acute and complex than A&E patients... which  
made for lots of adhoc problems and urgent tasks. Chemo [the chemotherapy  
centre] was less challenging overall – but not without complications. SU4FN 2*

While A&E patients presented considerable challenges, the way the department was organised and managed meant that the demands placed on individual nurses – including the need for unplanned tasks and interruptions – were generally moderate (although there were significant spikes in demands; AE2FN 1; AE5FN 3). The same could also be said of the chemotherapy centre, albeit the particular challenges in this setting were very different (DC3FN 2; DC6FN 2). That both settings were well-staffed, with a relatively large number of experienced nurses, was important, since many patient cases were complex, and because the need to meet targets (e.g. the four-hour maximum wait time in A&E; infection rate targets in the surgical ward), and to follow organisational protocols (e.g. regarding safe working) exacerbated the demands (AE4STAT 3,31; AE5FN 3; DC6FN 3). However, the need to devote time and energy in taking care of patients' emotional needs was probably lower in A&E and the chemotherapy centre than in the surgical ward because the former, unlike the latter, were not inpatient settings, and few had received major surgery, as many surgical patients had (SU1FN 1; SU4FN 1).

*I think it is for our patients [important to have their emotional needs met, as well as medical needs]. I think a lot of them... have had bad news recently and then they're in hospital having surgery, and it can be quite tough for them. SU4INT 4,2*

That both A&E and the chemotherapy centre had a dedicated ward manager was also helpful since he/ she planned the work of the ward as a whole, and, in doing so, he/ she was able to pre-empt unplanned tasks and potential problems (e.g. AE2SHA 4,39; AE6FN 1; DC3FN 1). The surgical charge nurse had a full workload and could not therefore dedicate him/herself to this role.

*Because the [ward management are] chemo-trained... [they] know what every regimen is, how long it entails for the patient to be prepared. DC4INT 10,24*

*I think the nurse-in-charge has a massive impact. I'd say the nurse-in-charge has more of an impact on how the shift is run, and how everyone feels, and how comfortable you are than the registrar in charge. AE5INT 16,25*

In A&E, close teamworking allowed nurses to delegate unplanned tasks, if needed, while the physical environment supported frequent communication with other nurses and emergency doctors (AE1SHA 2,16; AE5SHA 4,30 AE4FN 1). This further helped to pre-empt – and indeed to manage – any potential problems or unplanned tasks that arose (AE5INT 18,31; AE5INT 1,6; AE5INT 2,35).

The need for teamworking in the chemotherapy centre was lower, although chemotherapy nurses had to work with colleagues in the oncology unit, and the pharmacy, to get the information – and the drugs – they needed to provide patient treatments (DC2INT 7,12; DC3STAT 1,14). Nurses emphasised the

importance of planning the resources they needed from said department, and checking their availability, as breakdowns in the agreed procedures (e.g. for procuring prescriptions, patients' notes or drugs) were common, and they could cause lengthy delays (e.g. DC1SHA 1,45; DC2SHA 2,3; DC5SHA 3,22). This was especially problematic in the context of patients requiring long-duration treatments (some drug infusions took as long as eight hours), as the department was open to patients only between 9am and 5pm (DC2INT 4,20; DC3STAT 2,10).

*Say there is a patient who will come at nine o'clock [when the chemotherapy centre opened], a patient who is very quick, and then.... two long treatments for six hours... You can prepare everything before you call them, prepare all the things you need DC2INT 16,20*

While nurses' planning (e.g. of the resources they needed) often led to the identification of unplanned tasks – for example the need to speak to the doctor responsible for an omitted patient prescription – the perception that such planning could pre-empt disruption, and reduce delays, was thought to make it worthwhile (DC2INT 12,1; DC4FN 2). Communicating with other departments however was not easy, as they were physically remote, and chemotherapy nurses relied heavily on communications technologies. These did not, however, provide reliable access to the relevant individuals (i.e. pharmacists and doctors), and nurses often had to try multiple communications methods, or send multiple messages, to contact them (e.g. DC1SHA 1,21; DC5SHA 1,29; DC5SHA 3,30; DC5SHA 4,18). This, together with the need to handle returned calls or messages, presented further unplanned tasks (DC1SHA 2,1; DC2SHA 1,21; DC5SHA 4,30), and caused delays.

*...since it was not prepared well I have to do it [chase up the treatment]. And the worst thing is, you cannot treat that patient because all these things were not done properly. DC2INT 21,12*

Another source of unplanned tasks resulting from procedural breakdowns concerned the need to collect documents or drugs from the oncology clinic, or the pharmacy (SU2SHA 2,8; SU5SHA 3,5). When a Healthcare Assistant was working, however, chemotherapy nurses generally delegated such tasks (SU2SHA 2,8). All of the above challenges had to be handled alongside nurses' administering drugs for current patients.

*But bear in mind that at one time of the day I will have to look after four, five patients at the same time... chemotherapy, bag changes. DC4INT 3,3*

Patients were scheduled to arrive at fixed times so nurses had to work around these as much as possible – or at least keep patients updated regarding any delays – adding further demands (DC5SHA 1,27; DC4INT 25,24). Drug administration was itself a complex activity, as most patient treatments were comprised of multiple infusions, which required the use of different equipment (e.g. different 'giving sets' for intravenous administration), and had to be given over varying durations (DC2INT 4,20; DC3STAT 4,21). Furthermore, many drugs had to be administered in a particular sequence, and within a set time-frame, while the fact that most treatments were toxic meant that nurses were required to monitor infusions regularly (i.e. so they could respond quickly in the event of an 'extravasation' – where a drug leaked from the patient's cannula into the surrounding tissue – or an allergic reaction).

*And you have to really prioritise which goes first because like long treatments, you have to finish it within a span of time. Not like in the wards [in patient settings]... in here you have to really finish it within the opening hours of the unit (DC2INT 4,20).*

The surgical ward, in contrast to the other settings, was often poorly staffed, and experience levels on average were lower e.g. most surgical nurses were band 5 grade, while the majority in A&E and the chemotherapy centre were band 6 grade (SU1FN 1; AE3FN 1).

*We're always constantly without staff, which makes things harder because instead of me concentrating in a bay of six, I have to add two more patients.... I can't concentrate and give the attention of each patient as I would like to SU2INT 6,28*

One of the senior staff nurses was given the role of charge nurse, but he/ she had a full workload in addition to these responsibilities meaning there was little opportunity to plan the work of the unit as a whole, or to coordinate teamwork, as the ward managers in A&E and the chemotherapy centre could (SU4FN 1; SUSTAT 6,2).

The lack of available experienced nurses, together with the challenges of the physical environment (the U-shaped ward made it hard to find clinicians at times), made it difficult for staff nurses to obtain help when unplanned problems occurred (SU6FN 2). Such tasks arose frequently, however, as the need to coordinate multiple resources (e.g. other clinicians, drugs, drug giving equipment, monitoring

machines), and to orchestrate patient care in time and space (i.e. since many resources were available only for a limited period, and many tasks could take place only in a certain location), inevitably resulted in problems – and caused delays (SU3FN 1; SU5FN 1).

*Constantly you're trying to do something, there's always 'there's the phone for you'. Or 'I've changed the IV..' SU2INT 24,1*

Unplanned tasks were also thought to impact nurses' workloads, and, in turn, their work-life balance.

*[If an unplanned task] will take a lot of my time that means everything else will be delayed, and that means that I will be staying here until nine o'clock writing my medical notes SU6INT 20,11*

All of this added to staff nurses' workloads, and when nurses were unable to stay on top of these, further unplanned tasks were likely (i.e. because nurses were unable to respond quickly to events in order to pre-empt problems).

*That lady that I just discharged, I booked her transport for 11, but then I never managed to get ready on 11, so I called transport and... [cancelled them]. The first priority was to get her medication ready for her to take home.... And that means I need to communicate constantly ... [with the] doctor, to liaise with the alcohol and drug service, and with Social Services, and everybody else ... at the last point [transport] let me down anyway. And then you're back on the phone whinging at them. SU2INT 15,29*

As in the chemotherapy centre – but unlike in A&E – surgical nurses were physically separated from the medics whose patients they looked after – meaning they sometimes had difficulty resolving unplanned problems regarding patient treatments (SU3FN 1; SU3SHA 5,23; SU2INT 15,29). That the doctors visited the ward at set times however meant that queries could be ‘saved up’ – although this required surgical nurses to plan to fit their work around these times.

*They [the doctors] do come around and we've got two main ward rounds, and if we have any problems we can grab them. Otherwise, the bleep is just two seconds away... (SU2INT 16,18)*

The need to perform other tasks at fixed times – most notably the medications rounds (conducted at 8am, 12pm and 6pm) – also required advance planning and adaptation (SU3FN 2; SU4INT 5,24).

Many of the above-described challenges resulted in competing demands for nurses, as they perceived it. Surgical and chemotherapy nurses, and A&E nurses to a lesser degree, frequently began their shifts with a mental ‘to do’ list, comprised for example of their usual (i.e. *planned*) tasks, plus other jobs that were highlighted during the handover meeting (in the surgical ward and A&E), or through planning patient treatments (in the chemotherapy centre).

Nurses’ ‘to do’ lists often grew, however, over the course of the day as aspects of complexity and dynamism (including those highlighted in Table 4-6, above) resulted in unplanned tasks, and/ or led to the temporary suspension of nursing jobs e.g. pending the availability of a resource, or the resolution of a particular problem (AE5INT 1,6; AE5INT 2,35; SU2INT 11,29; SU4FN 1; DC1FN 2; DC5FN



1). There was however, more to nurses' perceptions of competing demands than a list of tasks. Said tasks still had to be completed within the constraints of complexity and dynamism (the exact nature of which, of course, depended on the precise context), which themselves were viewed as demands that had to be managed (AE6FN 2; SU03FN 1; SU4FN 1; DC1FN 2; DC5FN 1).

*And I personally... everyone does tend to make notes on their handover, and it's a very 'nursie' thing, you'll put a little tick box there [nurse points to her 'to do list'] and then tick it when you've done it... In handover, you start to get an idea of what you need to do [during the shift]... Or if somebody is going for a scan at a certain time, you want to make sure that person is ready [nurse points to specific items on her list].... I'm very much a person who will make a list... SU4INT 11,9*

*We have our list of patients – you've seen it... you have to plan that, you have to prioritise. Say there is a patient who will come at nine o'clock, a patient who is very quick, and then [you might be required to administer] two long treatments for six hours. We might have staff off sick or something like that... so you have to always communicate not only to your patient, but to the Aseptic unit [in the pharmacy] so that they know we will start late, and then we can prioritise. It's the same thing that's happening, if you start late, 'Okay, can I just prioritise as well with them.' DC2INT 16,14*

*I think you have a certain amount of tasks that you know you have to do and you tick them off in your heads, and there's always stuff being added on top of those. You have to jiggle things around in your head. AE5INT 19,23*

## 4.4.2 The Nature of Nurse Interruptions

*Note: readers who have forgotten the distinctions made in the introduction between different aspects of interruption, or other elements of the definitions, might consider revisiting these since they are crucial to understanding many of the findings presented below (section 4.1.2, page 113).*

The list below summarises the main findings regarding the nature of nurse interruptions.

- 1) The need for, and the nature of, interruptions emerged in relation to unplanned tasks and competing demands
- 2) Most interruptions were self-initiated, and they supported the handling of competing demands in a variety of ways. They:
  - Enabled rapid responding to urgent tasks
  - Helped to reduce memory demands
  - Supported obtaining information
  - Allowed nurses to remain productive during a delay
  - Enabled nurses to utilise limited opportunities to access resources
  - Supported coordination of temporal and sequential requirements
  - Allowed nurses to monitor tasks and keep track of events
- 3) As well as supporting the handling of competing demands, interruptions also added to these
- 4) Nurses managed unplanned tasks and interruptions in relation to competing demands. This required prioritising tasks and activities, planning and cost-benefit analysis
- 5) Nurses generally avoided interruptions to deal with unplanned tasks

- 6) Nurses used the environment, as well as specific tools and systems, to support their handling of unplanned tasks and competing demands
- 7) Experienced nurses were better able to determine the need for an unplanned task
- 8) More experienced nurses were also considered more effective in handling unplanned tasks – and competing demands more generally
- 9) Multiple effects of, and perspectives regarding, interruptions

#### ***4.4.2.1 The need for, and the nature of, interruptions emerged in relation to unplanned tasks and competing demands***

Complexity and dynamism resulted in unplanned tasks and competing demands for nurses, and it was the latter requirements that produced the need for – and shaped the character of – interruptions. One source of evidence that supports this assertion relates to the relative frequency of interruptions in different settings. Interview and observation data suggested that interruptions occurred most often in the surgical ward, followed by A&E, where unplanned tasks and competing demands (and indeed, complexity and dynamism) were also most apparent (AE3FN 1; SU4FN 2; DC6FN 1).

#### ***4.4.2.2 Interruptions were self-initiated and supported the handling of competing demands***

Most of the observed interruptions were self-initiated – and only on occasion did they occur in response to an obvious external event (i.e. an event that forced them to ‘drop everything’ to respond to a required task (AE4FN 3; AE6FN 1; SUSHA 4,18; SU6FN 1; DC3FN 1).

*Fieldnotes: few interruptions were forced on nurse by some spontaneous [external] event ... even when nurses did switch immediately to... [handle an unplanned task] this was less because they were forced and more because they needed to respond to changing priorities AE6FN 1*

*Fieldnotes: nurse's switching [interrupting was] sometimes accompanied by some obvious external signal (e.g. a pump alarm)... but often it wasn't... switching often seemed voluntary and strategic sort of... DC3FN 1*

*Fieldnotes: only a small number of interruptions were imposed on the nurse this morning (e.g. during beds and meds round). In most cases nurse switched because it made her work easier somehow SU6FN 1*

*You have to stop something to go to do something else... something that has a priority...it's the nature of the work... I think it's a positive thing to happen. Because if that didn't happen, you wouldn't be able to provide in an emergency department – in any department, dealing with the people – quality care. AE4INT 18,11*

The benefits of interruptions identified by the study are described in the sections that follow.

### **Enabling rapid responding to urgent tasks**

Interruptions allowed nurses to respond quickly to new – and often urgent – demands. By switching before a current task was completed, nurses could react

quickly in the event of an emergency, and potentially pre-empt a patient situation from becoming more serious.

More emergency events were observed in A&E than anywhere else, although numerous urgent tasks were also observed in the surgical ward – especially in the HDU – and the chemotherapy centre. Interruptions allowed A&E nurses to respond quickly to trauma calls on several occasions (AE3SHA 6,40; AE6SHA 1,34). The ability to provide immediate support in handling trauma cases was vital since patients were usually in a critical state, and they required urgent and extensive treatment.

*Fieldnotes: The nurse today could not afford to finish her tasks before switching/ interrupting.... she had to respond to emergencies and unexpected requests all of the time... [not interrupting would have] delayed urgent tasks... (AE3FN 1)*

In the surgical ward, interruptions enabled nurses to respond quickly to potentially serious changes in patient conditions (e.g. as indicated by vital signs monitoring machines SU3SHA 3,29; SU4SHA 3,3), while chemotherapy centre nurses interrupted tasks in order to deal with patients' bleeding or potential extravasation events (DC2SHA 2,7; DC5SHA 2,33).

### **Reducing memory demands**

Interruptions could reduce memory demands since they allowed nurses to address a task immediately i.e. to 'get it out of the way', and save the need to recall it later. Nurses explained interruptions on several occasions by saying they needed to do a job "before I forget" SU1SHA 1,34; DC5SHA 2,3. This approach

seemed to be used primarily to handle quick tasks (e.g. responding to a quick question AE2SHA 1,37; AE3FN 2; SU1SHA 3,1; DC4SHA 2,33), or those that were not part of nurses' normal routines (and hence which might be more easily forgotten). Emergency and surgical nurses addressed non-routine administrative jobs, such as filling in a form for an adhoc patient scan, immediately (SU5SHA 2,28; AE4SHA 3,20; AE6FN 1). The following quotations suggest surgical nurses recognised the benefits of getting tasks 'out of the way' immediately, and were concerned about having to remember tasks.

*But [if] it's something that is a one off thing, and as I said to you... I'd rather finish that... I'd rather do that, and it's out of my way. Because we're human, we do forget them. SU2INT 12,23*

*It's possible that you'll forget if you don't do it straight away... Because I do forget.... And I'm sure everybody else does. DC4DI 13,16*

*Fieldnotes: seems a clear tendency to nurses to interrupt tasks for quick unplanned tasks... maybe the costs of quick interruptions (e.g. need to resume current job) are outweighed by benefits of avoiding need to remember interrupted task? (AE3FN 3).*

### **Obtaining information to support the handling of competing demands**

Another benefit of interruptions concerned the ability to obtain information to support the handling of competing demands (as opposed to the handling of current tasks). Many of the above examples of brief communication exchanges

were motivated by such a desire – or appeared to be (e.g. AE2SHA 1,37; AE2SHA 5,11; SU1SHA 1,42; DC5SHA 1,27).

On a related note, nurses were observed on a number of occasions switching between (by repeatedly interrupting) apparently ‘interdependent’ tasks i.e. tasks that were mutually supportive because each provided information relevant for the completion of the other. These tasks could be identified on the basis that they shared some underlying goal, and nurses tended perform just one ‘part of a task’ each time they switched. In A&E, and in the surgical ward, examples related to assessing patients; nurses switched while conducting assessments between asking patients how they felt, looking at patient records (e.g. drugs and fluids charts), and taking observations – since all supported their understanding of the patient’s current condition (SU4FN 1; SU6SHA 5,7; AE3SHA 6,40; AE6SHA 5,11). The best way to illustrate this is to provide a rich example from the raw data. The following (edited) example shows how the ambulance triage nurse switched among different patient assessment activities – in particular asking direct questions of the patient (underlined), and other, related activities (AE6SHA 5,11 to 5,24).

*5,11 new triage patient arrives with [ambulance crew]. Nurse introduces herself and starts to assess him. Young man (c.30 yrs) who has fallen off a motorbike and hurt his leg*

*5,14 nurse asks patient how he feels and where it hurts. He explains briefly*

*5,15 nurse asks questions of the paramedics regarding where and how patient was found... and then asks patient a couple of further questions about his general health...*

*5,17 nurse checks patient observation on the PRF form filled in by crew... then she asks patient some more questions about his accident*

5,19 nurse starts blood pressure monitor (takes a minute)... and while cuff is inflating she asks more questions about where patient feels sore

5,20 she looks at BP reading and then goes to find charge nurse. Finds CN and describes her assessment of leg injury... charge nurse suggests to put him in majors if patient feels pain in a certain place [I didn't understand CN references to anatomy]... and if there is room nurse then asks more questions of patient

5,26 nurse checks something on computer system (maybe free rooms?)... she asks patient a final question (I did not hear/ understand the question) and makes some notes before calling forward the next patient)

### **Allowing nurses to remain productive during a delay**

Interruptions supported handling competing demands by allowing nurses to remain productive when faced with a delay (i.e. since the nurse could switch to another task until the source of the delay was resolved). As noted above, many nursing tasks in all settings were delayed, or had to be suspended temporarily, pending the availability of a limited resource. Interruptions were common in scenarios such as these, since nurses felt the need to continue progressing their workloads (e.g. by working their way through their list of competing demands). Chemotherapy nurses performed other tasks when faced with delays in medication deliveries (e.g. DC2SHA 3,1; DC5SHA 3,17). Nurses caught up on documentation when patients were late for appointments (DC1SHA 4,2; DC2INT 17,1), as the nurse expressed below.

*Just like now, one of the chairs is vacated... 'Okay, maybe we don't have someone for an hour so I can use this time [to catch up with documentation].'*

*DC2INT 17,1*



A&E nurses performed administrative tasks when they were unable to progress complex care tasks without input from other clinicians (AE3SHA 5,35; AE6FN 1). The following quotation, from an A&E nurse, also captures the desire to remain productive.

*Or you sit and do nothing,.. but then you don't want to do that because you feel,  
'Could I be getting on with something else, could I be pre-empting something  
else?' AE1INT 21,12*

### **Exploiting limited opportunities to access resources**

While interruptions supported adaptation to resource-related delays, they also allowed nurses to take advantage of limited opportunities to access such resources. Emergency nurses made use of chance encounters with individuals in the department to exchange information (e.g. AE1SHA 1,36; AE3SHA 2,3; AE2SHA 5,11). In the surgical ward, a nurse interrupted a patient task in order to ask questions of the charge nurse at one of the few times she had been available that morning (SU1SHA 3,26). Chance encounters with colleagues were exploited in a similar manner in the chemotherapy centre – although these occurred less often since chemotherapy nurses' work was less team based (DC2SHA 1,27; DC4SHA 2,33).

*Fieldnotes: Several examples suggest nurse interrupted because there was an opportunity to finish a job, or grab a resource... Nurse grabbed colleagues needed for a task (e.g. physio were grabbed when she was there; docs were*

*grabbed during their rounds)... or to make use of equipment that was suddenly available (e.g. nurse grabbed IV pump from G bay)... (SU5FN 1)*

### **Supporting the coordination of temporal and sequential task requirements, and other aspects of complexity**

Interruptions supported the coordination of temporal and sequential task requirements, and other aspects of complexity e.g. the need to handle some demands concurrently; other task and organisational constraints. This point is well illustrated by examining chemotherapy nurses' drug administration responsibilities. As mentioned earlier, chemotherapy nurses were often required to administer multiple drug infusions to patients (e.g. anti-sickness, minerals, chemotherapy), and each infusion took between several minutes and several hours (DC2INT 4,20; DC2INT 16,20). Nurses were allocated up to six patients per day – all of whom had to be monitored while infusions were administered – and the need to deal with frequent delays in obtaining patients' treatments, or to handle patients' late arrival – created additional (competing) demands (DC2SHA 2,3; DC5SHA 3,22). To cope, nurses generally prepared an individual's infusion, hooked it up and started it – before then switching to another activity (often repeating this routine for another patient; DC4SHA 2,38; DC4FN 1). They frequently switched between jobs in order to monitor patients, and, for those having multiple treatments, they returned when the current treatment was finished to commence the next one (DC4SHA 2,38; DC4FN 1). While nurses might have planned the sequencing of activities to some degree (e.g. so that one patient's infusion did not end at the same time as another patient's), they appeared to rely on the infusion pump alarms to a large extent to indicate when

patients' drugs had finished (and hence when the next task was required; DC5SHA 2,17; DC5SHA 5,45; DC4FN 1).

*Fieldnotes: Nurse almost always reacts to pump alarm rather than pre-empting ... when asked she agreed that was probably accurate – although she said she wouldn't forget about a patient completely! (DC4FN 1)*

By switching among tasks (interrupting) flexibly, in this way, chemotherapy nurses could treat multiple patients (i.e. handle competing demands) simultaneously, and hence be more productive (DC5SHA 5,6; DC4SHA 2,38; DC5FN 5). Nurses' flexible interrupting – a behaviour which they described as “multitasking” – allowed them to deal with unplanned tasks, and to adapt to dynamism more generally (DC5FN 5).

*But bear in mind that at one time of the day I will have to look after four, five patients at the same time, which they require either clinical saturation, they require chemotherapy, bag changes. DC4INT 3,3*

*For example, I've got a patient now that I am dealing with, but instead of me progressing to that [other task that needs to be performed]... because there are things that were not done for that patient I have to, in between, do this and do that, just to push through with the treatment.... Multitasking, that's me!' DC2INT 22,13*

Similar examples to this were observed in the surgical ward medications round (SU4SHA 3,24; SU4FN 1; SU6FN 1). In this case however nurses' switching was driven primarily by the need to handle multiple unplanned tasks that were 'saved

up' by patients over the course of the day. (Note again that the nurse described this behaviour as multitasking.)

*I think also the drug round, you could also... You do end up doing little other things for them as you're doing your drug round, like pouring them a drink or flushing their feed line or something like that. I think the drug round you do a lot of multitasking (SU4INT 19,14)*

In A&E, temporal and sequential task requirements – and indeed concurrent demands – stemmed in large part from spikes in the workload. As noted earlier, A&E often experienced such spikes in the late afternoon and the evening (AE3SHA 1,3; AE6SHA 1,4; AE3FN 1). In the following quotations nurses describe this challenge – and how they switch flexibly between tasks to handle it.

*Because you're in the environment, you have one or two people at the same time sick, and you have to move from one to another... the most challenging and difficult thing is when you have too many demands at the same time, and you have to really do that. AE4INT 8,26*

*My multitasking would be doing a little bit of this, and then going to do a bit of that. So I'm doing one thing at a time, but doing a little bit then going to something else and then going to something else. AE5INT 24,18*

### **Allowing nurses to monitor tasks and patients, and keep track of events**

Frequent switching and interrupting enabled nurses to monitor tasks and patients, and keep track of events. Such behaviours appeared especially important in

A&E, and to a lesser degree in the surgical ward, since patients in these settings were most unstable, and because the physical environment made it difficult for nurses to physically see or hear their patients (SU6FN 2; AE4INT 6,34 AE7INT 1,20). (Both of these were less problematic in the chemotherapy centre.) It was suggested earlier that A&E and Surgical nurses' frequent short bursts of communication allowed them to share information, and to keep one another updated about changes in patient status (e.g. AE1SHA 1,36; AE2SHA 1,37; SU1SHA 3,1; SU4SHA 2,9). This suggests that nurses worked as a team to help one another keep track of events (SU4FN3; AE5FN1).

*So I find that they [HCAs] are great and if they find that they can see something not normal they will come and communicate with you, that you can act straightaway. SU2INT 21,10*

*Fieldnotes: one way to view nurses' frequent comms with colleagues is in terms of their helping each other to maintain awareness of what is going on... to keep track of their many responsibilities? AE5FN1*

While communication-related interruptions allowed nurses to maintain awareness of events, nurses also monitored patients and tasks more directly (i.e. by observing patients in person, or watching an activity being performed; AE5FN 2; DC4SHA 2,38; DC4FN 1). Often monitoring was fitted in around other tasks – in part because it often required only a very brief interruption to 'eyeball' patients – and also because nurses were often so busy that monitoring was low on their list of priorities – unless patients were unstable (AE5FN 2; DC4SHA 2,38; DC4FN 1).

*So you have a strategy of assessing quite rapidly... And for example, simple things like, 'Good morning,' if they reply your airways are fine. So you do quite a quick assessment. SU2DI 15,8*

A&E and surgical nurses fitted patient monitoring around their extensive walking around the ward (AE3SHA 5,35; AE4SHA 1,25). This often resulted in unplanned tasks – for instance nurses from both settings had to get painkiller drugs, and perform other jobs, to ensure patient comfort (AE4INT 1,16; AE2SHA 6,22; SU4INT 19,14). However, nurses were keen to provide good care, and hence they wanted to know about patients' needs.

*If somebody wants to interrupt you, you're getting interrupted. But you cannot avoid that if you're in this kind of environment... you have to see if somebody needs something. AE4INT 15,6*

It was considered that monitoring patients and events, through brief interruptions, might have supported nurses' awareness of events – which might, in turn, have facilitated clinical work (AE5INT 16,25; AE5FN 1; SU3FN1; DC6FN 2).

*Say for example, basically from the clinic itself, if you are aware of who you are going to call it will take less time. If you already know where the doctors are, it is not like you are guessing, if you've already got an idea what is happening in the clinic itself, which doctors are there, it will be easier for you to contact them. DC2SHA 6,16*

Monitoring might also have reduced the need for unplanned tasks e.g. because a problem identified, and addressed, at an early stage, might have prevented

deterioration in a patient's condition, or some other problem, that would have needed attention later (SU3SHA; 3,29; AE3SHA 3,6).

#### **4.4.2.3 Interruptions also added to competing demands**

While interruptions enabled the handling of competing demands, they also added to these demands on many occasions. Interruptions usually created the need to resume a (primary) task, and they often slowed the completion of said activities (SU3SHA 3,7; SU02DI; 20,11). On some occasions, they even led to the nurse forgetting these (SU6SHA 4,46; SU4SHA 3,25; DC4INT 11,19; SU4SHA 1,15; SU4FN 2).

*Interruptions caused a number of problems for the nurse... [these] could have had serious consequences... she was delayed by the need to find drugs that were not in the supply cupboard... and the nurse forgot to resume putting allergy tags on a patient after being interrupted SU4FN 2*

*[If an unplanned task] will take a lot of my time that means everything will be delayed, and that means that I will be staying here until nine o'clock writing my medical notes SU02DI; 20,11*

*Sometimes I have to ask myself, 'Did I forget to do anything? Did I do everything that I should have done for this patient?' DC4DI 11,24*

Some observed events suggested that interruptions sometimes result in poor prioritisation, while efforts were also required to consider how unplanned tasks should be best managed. Both of these are discussed in more detail below.

#### **4.4.2.4 Nurses managed unplanned tasks and interruptions in relation to competing demands**

Nurses were sensitive to the context provided by competing demands when handling unplanned tasks and interruptions. They prioritised demands based on their (perceived) medical importance and urgency.

A&E nurses deferred unplanned tasks to finish entering critical medical details to the computer system (e.g. AE3SHA 6,23; AE6SHA 1,24; AE6SHA 2,1) – or they at least completed a subtask, such as filling in one section of the screen, before switching (e.g. AE3SHA 3,30; AE3SHA 3,46).

*If you think it's more important, the [unplanned task], always it can wait.... Again it's a judgement that happens at that particular moment. A lot of times I'm busy with something and somebody says... and you say, 'I have something more important now, we'll do that later.' Always you can use judgement. AE4INT 6,17*

A&E nurses, also, however, immediately interrupted to respond to trauma calls (AE6SHA 1,34; AE3SHA 6,40), and urgent colleague requests (AE1SHA 3,23; AE6SHA 4,1).

Chemotherapy nurses asked patients to hold off from asking questions until they (the nurse) had finished setting up IV drug infusions (SU1SHA 2,14; SU3SHA 3,11) – but they interrupted tasks immediately in order to take urgent telephone calls (DC1SHA 1,15; DC1SHA 2,1)

Surgical nurses finished patients' drugs rounds before responding to colleagues' requests (SU4SHA 2,30; SU5SHA 3,8).



*I always finish, say, that patient [before switching to an unplanned task], but then I wouldn't continue with the medication round. I'd never stop in the middle of administering drugs, because that's when my – well, I think I'd be more likely to make an error... SU4INT 16,24*

Surgical nurses also, however, interrupted informal conversations with patients and colleagues straight away to respond to cardiac monitor alert (SU3SHA 1,20; SU4SHA 3,3).

As well as considering medical factors, however, nurses also paid attention when handling unplanned tasks (and competing demands more generally) to an array of relevant social, organisational and efficiency factors (SU4FN 2).

*Fieldnotes: prioritising was key given nurse's workload this aft... but nurse prioritised things based not just on doctor's requests or the handover details [i.e. medical information]... they also wanted to demonstrate care to patients, be quick and efficient, help colleagues etc. SU4FN 2*

Social factors that affect nurses' prioritising included the need to manage patients with differing expectations about 'appropriate' levels of care, and the need to manage relationships with clinical colleagues. Regarding the former, A&E and Surgical nurses appeared to – or admitted to – dealing first with patients who made more 'fuss' before others, at certain times (AE2SHA 6,22; AE6SHA 4,14; SU4SHA 4,43; SU7INT 5, 27). In terms of the latter, social power appeared to affect nurses' task management on a number of occasions. Surgical nurses admitted prioritising some consultants' tasks over others (SU4SHA 1,38; SU4INT

16,20), while A&E nurses immediately performed jobs requested by the registrar, even when they had more pressing concerns (AE5SHA 3,41; AE5SHA 4,27).

*There are certain consultants I wouldn't [keep waiting]... the ward says you should say to them that you are doing something.... but past experiences, and having been shouted at and things, for a quiet life you just think, I'll do it now...*

*SU4INT 16,20*

At a general level, nurses were concerned to please their colleagues. In part, it was recognised, this was because they sometimes needed help from others themselves (AE4INT 9,9; AE5INT 13,30).

*There will be times when you're running around exhausted and you just need some help, and if you don't help people, they're not going to help you. (SU4INT 9,23)*

Organisational factors that appeared important included the need to meet hospital targets, and the need to follow established procedures. In A&E, several examples were observed where patients were prioritised because they were about to 'breach' (exceed the four hour maximum wait time) (e.g. AE5SHA 3,14; AE2SHA 4,31).

*I think also my job is to ensure people... there's the four-hour time limit and a big part of the job is to ensure that people are either discharged or admitted on time within four hours. AE5INT 2,23*

*Sometimes you'll have a decision made [regarding whether to admit a patient to A&E] with ten minutes to go before the breach time... and the pressure is now on you because it's your patient... AE5INT 6,27*

In terms of following procedures, surgical nurses, and chemotherapy nurses to a lesser extent, felt they had to prioritise documentation because of the potential organisational/ legal ramifications (SU2INT 5,4; SU2INT 5,24; AE4INT 5,6).

*Patients do complain that they haven't got that olden days nursing care, because we've got a pile of paperwork that we have to fill in for each patient, and that takes our time... But then if you don't fill in the paperwork you end up in court, and you haven't got proof that you've done the work (SU2INT 7,17)*

Efficiency considerations that affected prioritising included the need to manage time effectively. Nurses set specific time goals to complete certain tasks, and they endeavoured to meet these as best they could (SU02DI; 19,22; DC22DI 17,11).

*I try and get the medication and the patient comfortable straightaway in the morning, have their dressings done... and straightaway my medical notes... if I can manage to do that before lunch that means in the afternoon if anything comes up I don't have to be worried [about getting all the work finished]...  
SU2INT 19,22*

*I like to get all my jobs done before I've had my lunch, and then I can sit and write my notes after that. SU4INT 12,3*

As well as prioritising, nurses' handling of unplanned tasks (and competing demands) also involved planning and anticipating the potential effects of interruptions, on the workload as a whole (including both the performance of the current task, and other competing demands), and conducting cost-benefit analysis regarding these effects.

In the chemotherapy centre, nurses considered in handling time consuming unplanned tasks, the potential knock on effects on their ability to provide patient treatments – including those that had yet to be started. Several examples were recorded of nurses discussing whether and how unplanned tasks could be accommodated within the wider workload, and with regard to specific task-/organisational constraints, with the chemotherapy centre manager (DC4SHA 3,5; DC4SHA 4,15).

*And you have to really prioritise which goes first because like long treatments, you have to finish it within a span of time. Not like in the wards [in patient settings]... in here you have to really finish it within the opening hours of the unit (DC2INT 4,20).*

In A&E, a nurse deferred an unplanned task, not because her current (primary) task was more important than the requested (secondary) task, but because the job she was about to start had to be completed imminently (AE5SHA 3,14; AE5FN 2). The nurse described the challenge of handling unplanned tasks in the context of competing demands as follows.

*You have your list of tasks that you need to do [competing demands] and then someone will add in another task... you have to juggle things... It's a massive balancing act all the time (AE5INT 21,19)*

Evidence of nurses' cost-benefit analysis could be seen in their weighing up different priorities, and trading off potential effects of interruptions, given the specific context. Surgical and chemotherapy nurses traded off the need for efficiency with the need to prioritise patient safety (SU2INT 23,5; SU2FN 1; DC2INT 17,11; DC2FN 2).

*Well, they are [keen for nurses to avoid injury]. So you have 'safe' ways to move the patient, which usually are quite longwinded ways, which in A&E you don't have the time to do. So actually, you do put yourself at risk, because you've got time constraints you've got to meet. AE5INT 6,13*

At very busy times however, both cost-benefit analysis and prioritising were sacrificed so that nurses could react to urgent events.

*All the time we do [prioritise and work strategically], 'That I'm going to do first, second, third,' when it's appropriate. But sometimes you cannot, you don't have time... AE4INT 14,1*

#### **4.4.2.5 Interruption avoidance**

Observations and interviews suggested that interruptions were avoided by nurses (that is, nurses deferred, delegated or rejected tasks) more often than they were accepted – at least when nurses were required to perform more substantial tasks i.e. tasks that were expected to take a long time, or which were difficult in some

way.<sup>13</sup> Nurses claimed that they did not like to switch immediately to such jobs for fear of forgetting what they were doing when interrupted (DC4INT 11,24; DC4SHA 2,33; SU2INT 12,25; AE5SHA 3,47; AE3FN 2; SU5FN 1). It was also noted in the fieldnotes that being constantly interrupted might impair productivity (SU5FN 1).

*Fieldnotes: nurse showed a definite tendency to defer unplanned tasks... apart from small [quick] and simple jobs, which she tended to do on the spot AE3FN 2*

*Fieldnotes: constantly interrupting probs [would have resulted in the task] taking much longer than if done all in one go [i.e. in one continuous spell]... SU5FN 1*

*I like to do a task, complete it, and move onto the next one. AE5DI 18,31*

While nurses generally preferred to avoid interruptions, they were always sensitive to the specifics of the context in making a judgement.

*If I'm right in the middle of a task, I will. I'll say, 'Just tell me in a minute.' But it depends what they're telling me as well. If they're telling me about that patient right there in front of me and they're telling them something, I'll say, 'Okay.' But yeah, most of the time I'll say, 'I'll just finish here SU4DI 16,14*

*I'd rather finish [a current task]... if I hadn't got any more priority... Because we do forget them [interrupted tasks]. SU2INT 12, 25*

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<sup>13</sup> The demands of taking qualitative notes did not allow for the formal quantification of nurses' use of different fundamental strategies; these results are based on the researcher's qualitative impressions.

Where nurses did interrupt a current task, they frequently finished a subtask before switching. A&E triage nurses for example often deferred patient handover for a brief period while he or she finished writing key patient observations (e.g. AE3SHA 3,30; AE5SHA 3,46). When asked about this during a break, one of these nurses said that they might have forgotten some key information had they not written it down (AE3FN 2). A surgical nurse described in the following quotation her aversion to interrupting administering drugs to an individual patient – one subtask in her (multi-patient) medications round.

*I always finish, say, that patient [before switching to an unplanned task], but then I wouldn't continue with the medication round. I'd never stop in the middle of administering drugs [for a single patient] because that's when my – well, I think I'd be more likely to make an error... SU4DI; 16,24*

While it was expected that differences would emerge between settings in nurses' use of these 'fundamental handling strategies' (i.e. deferring, delegating rejecting, and interrupting), relatively little variation was found. Chemotherapy nurses however, were less likely to delegate unplanned tasks than their counterparts elsewhere (DC5FN 2), while surgical nurses seemed more likely to defer and reject tasks (SU4FN 1; SU6FN 1). The former could be explained by the fact that chemotherapy nurses' work was less team-based than surgical or A&E nurses' jobs were (DC5FN 2). The latter might be attributable to the earlier mentioned finding that surgical nurses' work was more complex and dynamic than was emergency or chemotherapy nurses' work – and because surgical nurses faced more unplanned tasks (SU6FN 1; SU4FN 2; AE6FN 1).

*Fieldnotes: nurse had a lot unplanned tasks today and she never seemed to catch up with her workload [competing demands]... Surgical ward probs the most chaotic/ dynamic setting based on what I have seen [of the 3 settings] so far? SU4FN 1*

*Interruptions were less problematic where a nurse's colleague was able to take over the original (primary) task, as was observed on several occasions.*

*EXAMPLES... Receiving support from colleagues in this way removed the need to remember and resume the original activity, and reduced the chances that this might be delayed.*

#### **4.4.2.6 The physical environment, tools and systems supported handling of unplanned tasks and competing demands**

Nurses often made a reminder of some kind for themselves when they interrupted or deferred tasks. A&E triage nurses annotated the 'paramedic assessment document' to help remember details of interrupted patient assessments – and they carried these with them while completing the additional (secondary) task (e.g. AE3SHA 3,46; AE3SHA 2,32). Chemotherapy nurses wrote reminders for themselves regarding the need to organise a patient appointment (DC1FN 1), or to pass on (to delegate) patient requests (DC5SHA 5,4).

Nurses used various tools to keep track of competing demands. Surgical nurses made notes on the handover sheet (SU3SHA 4,37; SU4INT 11,9; SU4INT 11,26) and the scheduler document (DC1SHA 1,9; also see DC2SHA 2,45), throughout their shifts. This allowed them to maintain a 'live representation' of their work,



which helped nurses to remember – and indeed to plan and prioritise – outstanding tasks (SU1SHA 1,8; SU6SHA 1,9; DC1SHA 1,9).

*Well, I prefer to use my [scheduler document]; I don't like to write on my hands.*

*Different nurses have different systems of reminding, but I prefer to write on the*

*[scheduler] because I am always checking it.... Also, just by, for example,*

*checking the task from the rota, the planning schedule for today, that may remind*

*me to do something DC4INT 22,1*

During medications rounds, surgical nurses carried drugs charts around and ticked off drugs as they prepared and administered them (SU2SHA 1,49; SU2SHA 2,48). As well as helping them to maintain awareness of tasks, this also served as a prompt to support drug preparation (e.g. SU2SHA 2,48; SU5SHA 4,47).

*But I will then know, because obviously if I've picked up their chart and it's all*

*signed, I know that I've given them that medication. SU4INT 17,13*

A&E nurses used the computer system to provide a live overview of their work, for similar reasons (i.e. to support planning and remembering; AE6FN 3; AE4FN 1). Senior nurses in particular often used the system to check on outstanding patient tasks – and to help to prioritise these (e.g. AE5SHA 1,6; AE5SHA 2,35).

Nurses did not always make notes however. The following A&E nurse felt that at busy times, when demands were changing rapidly, this would be impractical.

*More or less, yeah [the nurse keeps most tasks in his/her head]. I mean, you don't have time to... it would be pretty impractical to keep notes... because everything is really quite in the near past or future, that is where the priorities are... [you are not planning ahead for] three or four hours, or for the next day.*

*AE4INT 14,14*

Pump alarms were, as noted above, used by chemotherapy and surgical to provide a prompt regarding the need to take down an infusion bag, and/ or to start a new one (e.g. DC5SHA 2,17; DC5SHA 5,45; SU4INT 13,5). Monitoring equipment was used extensively by surgical nurses, and those in A&E, mainly to raise the alert when there were abnormalities in patients' observations (SU7INT 6,18).

*If I'm giving an intravenous drug, not all of them have to go through a pump, but I will, because then it bleeps, and it reminds me that I need to flush that line.*

*SU4INT 13,5*

*If you set the alarm that [the need to remember to check on, or restart, a drug infusion] is one less worry. SU7INT 6,18*

The most acute A&E patients were allocated to one of the rooms nearest the charge-nurse area, where clinicians tended to congregate, and where patients could most easily attract nurses' attention (AE2FN 1; AE4INT 3,18). Surgical patients were also told that they could use their call bells if they wanted help.

*I will even say to the patient, 'If I haven't come back by this time' – if they want me to do like their wound dressing... please ring your bell.' I will ask the patient to remind me. SU4INT 13,5*

Clinicians reminded each other of tasks. In A&E, doctors reminded nurses of requests for tests or imaging (AE6SHA 3,6; AE5INT 4,8), while senior nurses often reminded staff nurses of key tasks.

*The nurse-in-charge phones [shortly before the patient is due to exceed the four hour maximum wait time, and she says] 'Why aren't they moving, why aren't they moving?' AE5INT, 6,27*

Each setting appeared 'rich' with potential task cues (e.g. SU2FN 1). There were examples on all wards of nurses spotting specific items, and apparently being reminded of a job e.g. a surgical nurse saw a greetings card and immediately remembered she had intended to give it to a patient (SU1SHA 1,34); a chemotherapy nurse was reminded of the need to obtain a particular type of giving set when she saw it in the clean utility (DC4SHA 2,8).

*I think you do use the environment, because you'll see stuff on their table, and you think, 'Oh, I need to do that.' Or if they've got a box, like a stoma care box, because you can't see a stoma, but that will prompt you that you need to check on that person's stoma. SU4INT 19,24*

#### **4.4.2.7 Experienced nurses better able to determine the need for an unplanned task**

Several findings pointed to the notion that experienced nurses were better at establishing the need for – and the potential benefits of – unplanned tasks. Experienced nurses were more critical when requested to perform a task, and more likely to ask questions about the proposed task. They were also better able to anticipate events, and to establish the likely implications of intervening (or not doing so). Overall, experienced nurses rejected unplanned tasks more often.

*Fieldnotes: today's nurse more likely than other nurses I've seen to question others' requests – and more likely to reject UT [unplanned tasks].... she was not being difficult but seemed better able to see the big picture than others... she is very experienced... and maybe she was better at determining whether/ how a job needed doing? SU5FN 1*

*Fieldnotes: charge nurse today... this was her first ever shift in the role and she did not seem in control... she seemed to jump all over the place... she responded to every request for help where other CN [charge nurses] generally suggested alternative ways of doing things [e.g. they rejected and 'rethought' proposed tasks]... AE2FN 2*

*I am much happier to use my judgement... to weigh everything up and use my judgement... then I can justify it [postponing tasks, and not following doctors' orders "to the letter"] to the consultant... the [staff] nurses feel they have to do what they are asked straightaway SU7INT 5,15*

Regarding experienced nurses' superior anticipating, this could be seen in senior chemotherapy nurses' anticipating breakdowns in the system used to obtain patients' chemotherapy treatments (DC5SHA 3,22; DC2INT 7,12; DC2SHA 6,16; also earlier quotation: DC24DI 11,12) – and hence in their identifying tasks that needed to be done to pre-empt such problems. Experienced surgical nurses were thought to be better able to 'see into the future' – which again might have enabled the better identification of jobs that would be required.

*I guess we [experienced nurses] can project... we can see into the future if that makes sense... I think we can see what is going to happen more easily [when compared with junior nurses] SU7DI 4,38*

The following quotation also shows a chemotherapy nurse's desire for up-to-date information to support anticipating. Both of the nurses in these cases were experienced individuals

*I always look at the updated rota, 'When is my next patient due in? What extra do I have to prepare? What care does he need? Are there any special needs?'*  
*DC24DI 11,12*

The following extract from the fieldnotes is from the same A&E observation session as described just above; it relates to the nurse working her first shift as charge nurse and it suggests that the nurse's lack of anticipating distinguished her from experienced charge nurses.

*Fieldnotes: Nurse seemed to react to events rather than anticipating them proactively (e.g. a doctor came to request a bed for a patient with a stoma – the*

*nurse seemed surprised by this despite the fact that the patient was on the system: AE2SHA 7,1) as others [more experienced charge nurses].... Seemed to do. Nurse did not use computer system to plan as others did. AE2FN 2*

An A&E nurse claimed that anticipating happened automatically, and did not require conscious deliberation.

*The more you get the hang of it, of the ward, the more that you know about it too and the more experience you have... because as I say, I don't think [about how to manage tasks; it happened automatically] AE4DI 4,8*

These findings, together with several others described earlier (e.g. regarding the self-initiation of interruptions, and their only *sometimes* being preceded by an obvious 'external event' indicating the need to switch) suggests that identifying the need for an unplanned task may be much more complex than simply identifying an objective 'stimulus' or alert for interruption. It would appear that some reasoning process(es), supported by experience, is involved in this.

#### ***4.4.2.8 Experienced nurses considered more effective in handling unplanned tasks and competing demands***

Experience also played an important role in supporting nurses' handling of unplanned tasks and competing demands. It was thought to support nurses' appropriate prioritising (prioritising in a manner that reflected the specific context; SU1FN 1; DC2FN 1).

*Again, that [the ability to prioritise patients appropriately] is a matter of experience, I do believe that.... If what you do is more important than whatever somebody is asking you, again you put it into context... and you use your judgement, that's it really. Or what experience you have, or what you learn, because you think that it's appropriate to do at that particular moment. AE4INT 11,24*

Problems with prioritising were observed after interruptions to several junior nurses (DC3FN 2).

*Fieldnotes: [inexperienced] nurse did not seem in control when she was acting as CN [charge nurse]... prioritising did not seem to come so easy to her [compared with other charge nurses] AE7FN 2*

*So actually, I might think a patient is very sick, but because of my lack of experience, they might not be.... [nurse discusses difficulties of prioritising and the need to raise the alert when a patient is very ill] AE5DI 13,1*

Prioritising was thought to be facilitated by knowledge; both clinical knowledge and knowledge of how the work system operates.

*Just little things, like not having to look up details of different drugs... because you know [about them]... lots of little things, they add up... you save time and it's easier to prioritise. SU7DI 4,34*

*It's about... how well you know the system, or how well you know what you are allowed to say or not to say, how it works. And that's knowledge again, it's experience. DC23DI 11,24*

Experience and knowledge also helped nurses to know 'what to look for' to enable rapid and easy prioritising.

*I think another thing is just have experience, so a wealth of background to fall back on, isn't it? Because having done a year, having experience and knowledge to fall back on is so helpful, it's such a vital resource. ... now having done a year [the nurse had one year of experience], you know what you're looking for. AE5DI 14,18*

Assessing patients accurately was thought by nurses to be key for proper prioritising (DC1FN 2).

*Well, you do need experience [to assess patients and prioritise effectively] and I will say that somebody, my seniors, more experts in assessing a patient, I may have missed something SU2DI 15,8*

*A good assessment means you're going to be able to meet properly their needs... The better they get that [a good assessment], the faster you are able to act on it. It of course depends on your knowledge. Sometimes they say things that I don't know really, even now, that you think, 'God, I don't know... what to do... AE4DI 1,31*



Experience was thought to facilitate adaptation to complex or difficult patient problems. Senior surgical nurses felt that their junior colleagues tended to organise their work in a very structured way, and could find it difficult to adapt to anything that was not routine (SU7INT 5,3; SU5FN 2). Illustrating this, a senior A&E nurse gave an example of an incident where a junior nurse asked for help in managing a patient when conventional methods had failed to remove an item from the patient's ear. The senior nurse was able to improvise, using unconventional tools, to remove the item (AE7DI 7,19).

#### ***4.4.2.9 Multiple effects of, and perspectives regarding, interruption***

Since interruptions comprised multiple aspects (e.g. primary and secondary tasks), and sometimes involved several individuals (e.g. a recipient and instigator), it was possible to identify multiple effects of these events – and manifold perspectives on them.<sup>14</sup>

In situations where interruptions were initiated by another person (e.g. as opposed to self-interruption), these tended to be more beneficial to the *interrupting* individual than they were to the *interrupted* nurse (although this was not always the case). In all settings for example, questions from patients (AE6SHA 3,35; DC5SHA 1,27; SU1SHA 2,14), relatives (AE4SHA 3,41; DC4INT 25,24; SU1SHA 2,14), and other healthcare professionals (AE1SHA 1,14; AE2SHA 4,27; DC5SSHA 2,10; DC23SHA 5,2; SU1SHA 3,1; SU4SHA 2,9)

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<sup>14</sup> Note: since interruption was defined as the *act of switching* from a primary task to a secondary one, it might be argued that said (primary and secondary) tasks were not “aspects of *interruption*”, but separate (albeit related) phenomena. However, this is something of a technicality and, on balance, it seems reasonable to describe tasks in these terms.

usually helped these individuals to achieve an immediate objective, but they only occasionally contributed to the interrupted nurse's goals – as far as this could be obviously discriminated (AE4FN 2; SU3FN 1; DC2FN 1).

*Fieldnotes: Interruptions seem much more helpful to interrupting nurses than to the recipient. The nurse [observed] today was continually interrupted by colleagues and patients with quick questions - but this was mostly in their own interests... it did not help the nurse much with her job... (AE4FN 2)*

Similarly, interruptions tended to be more beneficial for outstanding tasks on nurses' 'to do' lists – and for handling the wider workload more generally – than for the current or 'primary' task (AE4FN 2; SU3FN 1; SU5FN 2; DC2FN 1).

*Fieldnotes: Where interruptions were helpful for recipient [the observed nurse], this benefit was seen only much later... Maybe it would not really be an interruption if it was immediately helpful?! (AE4FN 2)*

Consistent with the idea that interruptions had multiple effects, these events often appeared to have *both* positive and negative effects (i.e. simultaneously) on nurses' work. The need to resume a task was created on numerous occasions where nurses responded rapidly to urgent tasks (AE6SHA 1,34; SU3SHA 3,29; SU4SHA 3,3; DC5SHA 2,33), reduced memory demands (SU1SHA 1,34; DC5SHA 2,3; AE2SHA 1,37), and switched to remain productive (DC1SHA 4,2; DC2INT 17,1; AE3SHA 5,35; AE6FN 1) – to give just a few examples.

That interruptions frequently had both positive *and* negative effects – often at the same time – suggests their overall contribution could only be evaluated through a

more macro, holistic evaluation of nurses' work. The concept of competing demands was useful in this regard since it allowed consideration regarding the degree to which the potential benefits of interruptions (e.g. for the wider workload) outweighed the potential costs (e.g. for the current task). Most of the interruptions described in the previous section, which had major benefits, did not also appear to impose significant costs; suspended tasks were generally resumed easily/ quickly, and any delays resulting from these events appeared manageable i.e. they did not obviously result in adverse effects (AE6FN 2; SU5FN 1; SU5FN 2; DC2FN 1).

This suggests that interruptions were positive on the whole (i.e. in *net* terms, with regards competing demands) – although several examples were also observed where nurses appeared to have forgotten to resume potentially important tasks – or had trouble resuming for some reason (implying that the interruptions might not have been worthwhile in these instances; SU02DI; 20,11; SU4SHA 3,25; DC4INT 11,19; SU4SHA 1,15; SU4FN 2).

## **4.5 DISCUSSION**

Nurses' work in all three study settings was complex and dynamic – as evidenced, for example, by the need to coordinate multiple resources, and to handle unplanned tasks and changing priorities. Surgical nurses' work, followed by that of chemotherapy, then A&E nurses, was the most complex and dynamic.

Complexity and dynamism resulted in competing demands for individual nurses. Nurses accumulated unplanned tasks on a (physical or mental) 'to do' list throughout their shifts, and these had to be managed in relation to planned

activities (i.e. tasks that nurses knew about at the start of their shift), and in the context of various clinical, organisational, and social constraints.

The need for, and the nature of, interruptions (defined as the act of switching from a primary task, before it was completed, to a secondary task) emerged in relation to competing demands.<sup>15</sup> Interruptions supported the handling of competing demands by facilitating timely responding to unplanned tasks, reducing memory demands, and allowing nurses to remain productive while they waited for a resource to become available. Interruptions also enabled nurses to exploit limited opportunities to access resources, supported the coordination of temporal and sequential task requirements, and allowed nurses to better monitor tasks and patients. The majority of interruptions were self-initiated (nurses interrupted themselves), and most were considered beneficial.

As well as supporting the handling of competing demands, interruptions also added to these. Nurses often (but not always) had to resume interrupted tasks, and they frequently had to consider how best to incorporate unplanned tasks into their wider workload. Nurses prioritised unplanned tasks in relation to competing demands, but they also had to plan and conduct cost-benefit analyses regarding how such tasks should be managed (e.g. to weigh up the importance of various contextual factors, and to trade off conflicting goals). At some times, the appropriate handling of unplanned tasks involved nurses interrupting a current task in order to switch tasks immediately; at other times it required nurses to avoid interruptions (e.g. by deferring or delegating unplanned tasks).

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<sup>15</sup>This definition (of interruption) differs from that employed by most extant studies of interruption, in that existing studies tend conflate the act of switching with the handling of the secondary task.

Nurses used experience and clinical judgement to determine how to best handle unplanned tasks – including deciding whether or not to interrupt in order to do this. Only rarely did interruptions occur in response to an obvious external event (i.e. an event that forced the nurse to ‘drop everything’ to respond to a task). This implies that the processes involved in instigating interruptions are chiefly subjective and internal (and not primarily objective and external, as existing models of interruptions imply).

Overall, nurses blended both strategic and reactive behaviours in managing competing demands. Strategic behaviours included planning, prioritising, and cost-benefit analysis, as well as using tools and artefacts, procedures, and other resources to support task management. Reactive behaviours involved exploiting chance opportunities to communicate, or to obtain resources, and using aspects in the physical environment to support memory and planning.

#### **4.5.1 Comparison with extant literature**

That the three study settings were dynamic and presented frequent unplanned tasks and interruptions was consistent with the extant literature (Grundgeiger and Sanderson, 2009; Rivera-Rodriguez and Karsh, 2010; Hopkinson and Jennings, 2013b; Coiera, 2012). The finding that some interrupted tasks are never resumed has also been established (Collins et al 2007; Brixey et al 2008; Brixey et al 2010; Grundgeiger et al., 2010; Westbrook et al., 2010b).

The sections below focus on four further aspects regarding the nature of interruptions to which the current study contributes: 1) the role of clinical context,

2) individual adaptation, and interruption handling, 3) experience and interruption handling, and 4) the costs and benefits of interruptions.

#### ***4.5.1.1 The role of clinical context***

Several studies have shown (as the current study did) that context influences the nature of interruptions. That the physical environment effects interruptions has been reported by several researchers (Grundgeiger et al., 2010; Ebright et al., 2003; Potter et al., 2005; Redding and Robinson, 2009), while the impact of physical cues in supporting remembering (to resume) interrupted tasks has also been noted (Colligan and Bass, 2012; Grundgeiger et al., 2010). Other aspects of the context found to shape the nature of interruptions include the team context (Grundgeiger et al., 2010; Trbovich et al., 2013; Klemets and Evjemo, 2014; Rivera, 2014), the need for communication, and the particular communications technologies used to facilitate this (Woloshynowych et al., 2007; Edwards et al., 2009; Klemets and Evjemo, 2014).

Two main findings regarding the role of context are new to the literature. These include that: 1) interruptions emerged from interactions among a wide range of context factors; and 2) a wide range of context factors (e.g. aspects of the physical environment, specific tools that were available) were used by nurses to support interruption handling. The first of these findings is important because it illuminates the complex aetiology of interruptions. The second finding is discussed further below.

#### **4.5.1.2 Individual adaptation and interruption handling**

That handling interruptions required the use of a number of adaptive strategies suggests that these events are more complex than has been appreciated previously. While the ‘healthcare complexity studies’ examined in the Literature Review (Ebright et al., 2003, Hedberg and Larsson, 2004, Potter et al., 2005; Wolf et al., 2006; Cornell et al., 2011) highlighted a number of forms of adaptation, these related to adapting to complexity *in general*, rather than to interruptions specifically (recall that interruptions was just one aspect of complexity that was examined by these studies). Studies of healthcare interruption have, like Phase One, highlighted the role of memory and/ or prioritising behaviour vis-à-vis managing interruptions (e.g. Grundgeiger et al., 2010; McGillis-Hall et al., 2010; Colligan et al., 2012) – but other adaptive strategies that were found to be important (e.g. anticipating, planning) have only rarely (or never) been mentioned in this context. Furthermore, the notion that a range of different strategies have to be combined to support interruption handling is a new one.

Many of the adaptive strategies found to be important in Phase One were incorporated in the ‘overarching’ concept of competing demands. Handling competing demands involved nurses using a range of behaviours (e.g. recording items on a mental- or physical list, planning, prioritising, anticipating, and cost-benefit analysis), to ensure that tasks were managed appropriately given the wider workload – and vis-à-vis the specific clinical, organisational, and social constraints. The term competing demands has been used by several healthcare interruptions researchers (Parker and Coiera, 2000; McGillis-Hall et al., 2010; Walter et al., 2013), but it has not been used to support formal attempts vis-à-vis conceptual development (as it is here).

The concept of competing demands bears resemblance to the ‘cognitive stack’ (a mental ‘to do’ list) first described by Ebright et al., (2003), but also examined by Potter et al., (2005), which captures how nurses accumulated tasks, and prioritised among these. A key difference however between competing demands and the cognitive stack concerns the recognition that it was not just tasks that competed for nurses’ attention, but also conflicting clinical goals imposed by individual, organisational and clinical constraints – and the need to trade-off different ways of working (e.g. speed versus safety). A further difference, as alluded to above, was that handling competing demands was thought to involve combining a range of adaptive strategies (not just accumulating and prioritising tasks, as per the stacking concept).

Another aspect of adaptation concerns the finding that nurses’ varied their use of ‘fundamental handling strategies’ according to the type of task they were asked to perform (see Literature Chapter section 2.3.1.4 ‘Interruption Handling Studies’). Specifically, nurses were more likely to defer when unplanned tasks were perceived to be more difficult or time consuming (compared to when they were seen as quicker or easier). Interruption handling studies have not considered the potential for this type of adaptation.

The above finding might also help to explain another finding regarding the relative frequency with which different ‘fundamental handling strategies’ were used by nurses. The current study found (based on qualitative data) that nurses deferred unplanned tasks more often than they immediately switched – in contrast to other interruption handling studies which reported just the opposite (Collins et al., 2007;



Drews, 2007; Biron et al., 2009a; Trbovich et al., 2013).<sup>16</sup> It is possible that, in the context of the current study, more weight was given in to more ‘substantial’ (e.g. more difficult or time consuming) tasks, since these might have appeared more salient. Other possible reasons for the discrepancy between the current study, and previous research, include that the current study settings were very different to those examined elsewhere, and that other studies were more precise and accurate (the current study finding was qualitative and therefore impressionistic to some degree).

More basic criticisms of ‘fundamental interruption handling’ studies relate to how ‘interruption handling’ was conceptualised. First, most of the so-called ‘handling’ strategies involved the *avoidance*, rather than *handling* of interruptions (i.e. since most enabled the avoidance of switching tasks before a current job was completed). Second, many interruption handling behaviours identified in Phase One could not easily be coded vis-à-vis a set of ‘fundamental strategies’. These included scenarios where tasks were deferred or delegated, but never actually performed; and tasks that the nurse was intending to do but a colleague had already performed before she got to it (without the nurse having to delegate the task).

The third criticism applies not only to interruption handling studies, but to the vast majority of healthcare interruptions studies. The finding that unplanned tasks were identified – and mediated – more through subjective, internal (i.e. cognitive) processes than through the detection of an ‘external alert’ for interruption raises

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<sup>16</sup> Studies of task management *in general* agree with the current study, and disagree with interruption handling studies, in indicating that health professionals generally avoid interruptions where possible (Catchpole et al., 2013; Anger et al., 2013).

questions regarding how accurately different handling strategies were – or indeed could be – recorded. Given that interruptions themselves can be considered a handling strategy (a strategy for handling unplanned tasks), this also raises concerns regarding the validity of all studies that have entailed counting and categorising these events. Identifying interruptions, and distinguishing among interruption handling strategies, was made easier in the current study since the researcher was able to ask nurses questions about interruptions, and their perceptions of different tasks, while he also had access to nurses' running commentaries (at less busy times).

The notion that interruptions were determined more through internal processes (self interruption) than through the occurrence of external events (external interruption) contradicts extant research. Studies that have compared the relative frequency of self- and external interruption suggest that the latter occurs much more frequently (Brixey et al., 2008; McGillis-Hall et al., 2010; Kalisch and Aebbersold, 2010; Kosits and Jones, 2011; Berg et al., 2013). Potential explanations for this discrepancy include that the current study conceptualised and defined interruptions differently, and that the researcher's presence might have had a greater impact on the results, compared with previous research (Unlike in the current study, the researcher was usually a clinician themselves. Participants might have changed their behaviour less when shadowed by a peer.)

More controversially, it might be argued, based on the current study's findings, that the distinction between self- and external interruption is a false dichotomy. All interruptions will, inevitably, be determined by the interplay between external events and internal thought processes – meaning that all such events can be considered at once internally- (self) and externally driven.

#### ***4.5.1.3 Experience and interruption handling***

Only a small number of other studies have considered the role of experience in handling interruptions, and these identified fewer – or more ‘narrow’ – ways in which experience might help than did the current study. Colligan et al., (2012) for example suggested that experience might support task prioritisation, while Rivera (2014) found that experience might allow nurses to better identify an appropriate time to interrupt others. That experience was especially helpful in identifying necessary (unplanned) tasks has not been reported elsewhere.

#### ***4.5.1.4 Costs and benefits of interruptions***

A number of studies have reported that interruptions have benefits (e.g. Hedberg and Larsson, 2004; Potter et al., 2005; Sasangohar et al., 2014; Rivera, 2014) and are generally accepted by nurses (e.g. Potter et al., 2005; Laxmisan et al., 2007). The benefits discussed in these studies however related primarily to communication, or the obtaining of information, however Colligan and Bass (2012)’s finding that nurses sometimes interrupted to take advantage of adhoc opportunities to complete a task is similar to the ‘exploiting limited opportunities’ strategy described above.

The concept of competing demands is particularly helpful for understanding the benefits of interruptions, since many such benefits related to the outstanding (non current) tasks that nurses accumulated on their ‘to do’ lists. The narrow focus in existing interruption studies on the need to resume a primary task serves both to mislead the reader about the context (i.e. since clinicians have to worry about completing multiple outstanding tasks, within prescribed constraints) and to

present an unduly negative view of these events (while the need to resume a primary task might be unfortunate, the benefits for the nurse's wider workload might outweigh the costs vis-à-vis the primary task).

Another benefit of the competing demands concept is that, by recognising that interruptions both add to, and support the handling of, competing demands, it can account for the finding that interruptions might have both costs and benefits *simultaneously*. While one or two researchers (e.g. Rivera-Rodriguez and Karsh, 2010; Rivera, 2014) have considered that there may be multiple dimensions of – and multiple perspectives regarding – interruptions, this study is the first study to link this to an overarching, organising concept (i.e. competing demands).

#### **4.5.2 Implications for the traditional account of interruption**

The study highlights six key shortcomings of the traditional account of interruption (see Literature Review section 2.3.1), in terms of its ability to account for the heterogeneity and complexity of nurses' task switching behaviour.

First, that nurses frequently avoided interruptions (e.g. by deferring, delegating and refusing tasks) challenges the main tenet of the traditional account (i.e. that individuals must switch immediately, more or less, to handle such tasks). This also implies that nurses have more control over events than has been recognised.

Second, the finding that nurses thought about their wider workload – including the specific demands of multiple 'outstanding' tasks (i.e. tasks on a 'to do' list) – when considering how to handle unplanned tasks challenges the idea that a

model comprised solely of a 'primary' and 'secondary' task, can illuminate complex clinical work.

The third shortcoming of the traditional account concerns the finding that the importance and priority of tasks were the main determinants of interruptions. The traditional account implies that the attributes of being 'unplanned' and 'external' are the main determinants. (This also helps to explain the first point made above, since nurses were more concerned about the clinical relevance of tasks than the other suggested attributes, when deciding how to handle them.)

Fourth, the finding that nurses seemed to find switching beneficial in many cases (e.g. where tasks were interdependent, where monitoring of patients or tasks was required, or when there were delays) challenges the notion that this behaviour is necessarily disruptive.

Fifth, the finding that interrupted (primary) tasks were often not resumed – and secondary tasks were themselves often interrupted – directly contradicts the traditional account. This also suggests the need to distinguish among several different aspects of interruption – aspects that are conflated by the traditional account. These include: 1) the act of switching from a primary task, before it is completed, to a secondary task; 2) the completion of the secondary task; and 3) resuming the primary task.

The sixth, and final, shortcoming relates to the findings that experience and clinical judgement played a significant role in both the identification of 'required tasks', and in determining how these were managed. The traditional account maintains that the identification of required tasks involves the detection of an

‘external’ event (i.e. something that happens in the environment to signal an upcoming interruption). The current study however found no evidence for the existence this kind of ‘objective stimulus’ for interruption. Instead, subjective perceptions, supported by experience, were involved in determining whether tasks should be performed.<sup>17</sup>

To summarise, the traditional account was far too prescriptive to be able to account for the range, and the complexity, of the events and behaviours observed.

### **4.5.3 Limitations of Phase One**

A number of important limitations of Phase One should be highlighted, relating in large part to the methodology – and especially the use of qualitative methods. The study was small in scale, and it involved only a modest quantity of data collection. Qualitative observations provided only impressionistic data regarding the relative frequency of events and behaviours, and about the temporal flow of nurses’ work (time was recorded, in the observation notes, every 15 minutes or so, but this provided limited insight regarding, for example, how long interruptions took to complete etc). It is also possible that the researcher’s presence effected the results, although it is not clear exactly what impact this might have had.

Other limitations regarding the observation method concern the lack of a deep understanding of the work being observed. While considerable efforts were made

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<sup>17</sup> The finding that nurses’ interrupted tasks in the absence of any obvious ‘external’ event also undermines the notion that tasks are ‘detected’ in some simple way.

to describe key aspects of nurses' work in each study setting, it was not possible to obtain, in advance of the research, a deep appreciation of each nursing activity that might be performed. For reasons stated in the Method, it was considered desirable to observe a wide range of nursing tasks – however the downside of this was that nurses' work could not be described in detail prior to the study. Such a detailed description would have provided greater precision in determining, for example, when a task had been interrupted. The study showed that interruptions do not necessarily follow an obvious external event (i.e. it was not always clear, based on observations alone, when an interruption had occurred), hence having a detailed account of the work might have enabled more accurate recording of these events.

The interview method used in the study also had shortcomings. The interview examined nurses' general perceptions of interruptions and competing demands, but relatively little of what was discussed was grounded in specific examples or events that had been observed by the researcher. When specific examples were given, these were often historic in nature, and they might thus have been distorted by memory or post-hoc rationalisation (the tendency to explain behaviours in terms of what would appear, in hindsight, to be rational – rather than having people explain their thought processes in real time).





# Chapter 5 Concept Development

The Phase One study revealed considerable shortcomings regarding the ability of extant conceptual accounts of interruption to explain nurses' task switching behaviour in dynamic clinical settings (or at least, in the specific settings included in this research). In addition, the Literature Review highlighted the absence of a clear, shared understanding of interruption. The aim of the current section was to develop a new conceptual framework that could address these shortcomings, and which could provide a more robust basis for further research on interruptions.

To support further interpretation of the Phase One results, and to facilitate conceptual development more generally, a narrative literature review was undertaken, examining research from several areas thought to be relevant to the topic of healthcare interruption. The findings of the narrative review are presented in the first part of this chapter, while a new conceptual framework of interruption is presented in the second part.

## 5.1 PART ONE: NARRATIVE LITERATURE REVIEW

Three broad areas of literature were identified as relevant through a combination of preliminary reading and discussions with the supervision team. These areas included: 1) interruption studies conducted outside of healthcare, 2) studies of multitasking, and 3) research regarding the nature of dynamic healthcare work.<sup>18</sup>

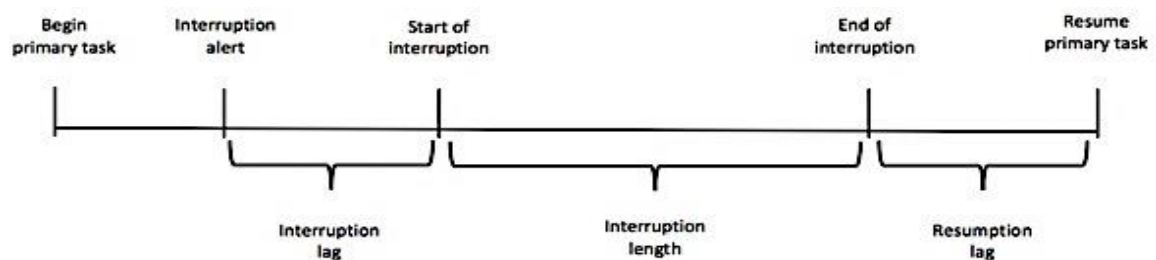
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<sup>18</sup> Narrative reviews are similar to scoping reviews in that they answer broad research questions, that may be only vaguely specified. Unlike scoping reviews however, narrative reviews do not involve systematic search methods (Arksey and O'Malley, 2005; Norman and Griffiths, 2014).

## 5.1.1 Interruptions Studies Outside of Healthcare

### 5.1.1.1 Interruption Timeline Models

A number of models describe interruptions in terms of a chronological sequence of events, with distinct aspects/ phases. Among the most widely cited of these is that of Trafton and colleagues (2003; 2007). According to this model, which is depicted in Figure 5-1, an 'alert' for a secondary task (e.g. an individual asking a question, or a telephone ringing) is said to occur while an individual is working on a primary task. After the alert, the individual is thought to take a moment to consider how the primary task might best be suspended (i.e. bearing in mind that it will have to be resumed later) – a period described as the 'interruption lag' – before the secondary task is commenced.



*Figure 5-1 Interruption stages in the timeline of interruption*

After completing the secondary task, the individual must consider where they 'left off' the primary task, and recover relevant context, to resume the primary task. The period required to do this (the time between finishing the secondary task and recommencing the primary one) is called the 'resumption lag'.

Trafton and colleagues (2003; 2007) claim their model captures the main constraint, and the main opportunity, for those who must manage interruptions. The main constraint is represented by the resumption lag, since the need to

recommence the primary task is expected to be taxing. No such lag period would be required if the primary and secondary tasks were performed in serial (i.e. without interruption), hence the interruption lag might be seen to reflect the 'time cost' of interruption. The main opportunity relates to the interruption lag, as individuals use this period to 'prepare' for the later resumption of the primary task e.g. by mentally *rehearsing* task resumption.

Trafton and colleagues (2003; 2007) combined their timeline with a theory of memory to try to predict the nature and effects of interruptions. The said theory, Memory for Goals (Altmann and Trafton, 2002), is described in section 5.1.1.2.

Other timeline models include those described by Latorella (1999) and Boehm-Davis and Remington (2009), who work in the aviation and human factors domains. These are similar, in a number of respects, to Trafton et al's (2003; 2007) model – both include for example the notion of an 'interruption alert', and they describe similar 'lag periods'. However, they proffer more elaborate descriptions of the processes involved in handling interruptions, at different stages on the timeline, than do Trafton and colleagues (2003; 2007).

Latorella (1999) suggests the existence of a period of 'interpretation', where an individual considers the requirements of the interrupting task, followed by 'integration', where they plan how to handle the task, while maintaining the on-going activity. The integration stage is further broken down into three sub-stages, namely 'pre-emption' – ceasing work on the primary task, either immediately or after a conscious evaluation of the relative merits of primary and secondary tasks – 'switching or scheduling' – where the secondary task is attended to, or it is scheduled for later – and 'primary task resumption'.

Boehm-Davis and Remington (2009) also point out that the decision regarding when to switch might involve conscious deliberation regarding task priorities – or not (e.g. if the new task is particularly compelling there may be little need for deliberation). They also drew on an established model of expert decision making, the Recognition Primed Decision Model (RPDM; Klein, 1993; Klein, 2008), to describe how experienced individuals may be able to decide ‘automatically’ (i.e. with minimal conscious effort) how to handle interruptions. By recognising common task scenarios, and remembering how these were handled previously, individuals can massively simplify the demands of decision making vis-à-vis interruptions.

Similar to Trafton et al., (2003; 2007), Latorella (1999) and Boehm-Davis and Remington (2009) also draw on theories of memory to highlight the likely effects of interruption. Rather than discuss these authors’ interpretations of the said theories, however, these are reviewed, ‘first hand’, in the next section (5.1.1.2).

## **Summary and Evaluation**

The interruption timeline models are similar, in a number of respects, to the traditional account of interruption (see Literature Review, Chapter 2) – hence they may be criticised for some of the same reasons. The models assume the existence of an external, objective stimulus for interruption<sup>19</sup>, however Phase One suggested that experience and subjective judgement played a significant role in the identification of ‘required’ tasks. Two of the models (Boehm-Davis and

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<sup>19</sup> Boehm-Davis and Remington (2009) suggest that interruptions might be triggered internally as well as externally, however their account of internal interruptions implies that these relate to ‘foreign’ thoughts, rather than strategic and rational decisions.

Remington, 2009; Trafton et al., 2007) assume that the primary task must be suspended in order to accommodate the unplanned task (they assume that the recognition of the interruption 'stimulus' will automatically result in the suspension of the primary task – and the switching to the secondary one). However, Phase One demonstrated that nurses frequently avoided interruptions e.g. by deferring unplanned tasks until *after a current activity was completed*. Other criticisms include an inadequate emphasis on the wider context of interruptions, and a lack of appreciation of their benefits.

Positive aspects of the timeline models include their recognising specific lag periods before and after interruptions, and their describing behaviours that occurred during these times. The recognition by two of the models (Latorella, 1999; Boehm-Davis and Remington, 2009) that the challenges of interruption relate not only to memory, but also to other processes, such as prioritising, is also positive – and consistent with the Phase One findings.

Latorella's (1999) *integration* stage is useful since it describes how unplanned tasks must be assimilated vis-à-vis the wider workload. This notion is similar to the Phase One finding that unplanned tasks were handled in the context of 'competing demands'.

Boehm Davies and Remington's (2009) suggestion that interruptions might be handled automatically, as per the Recognition Primed Decision (RPD) Model (Klein, 1993; Klein, 2008) seems credible, and it might help to explain why experienced nurses were better at handling interruptions in Phase One.

A final positive feature concerns the integration of Trafton et al's (2007) timeline with a wider theory of memory. The relevant theory, among other memory theories, is reviewed in the next section.

#### ***5.1.1.2 Interruptions and Theories of Memory***

Given the central role of memory in interruptions, theories of memory might shed light on the challenges of handling these events. Among the most prominent such theories include 'goal activation models' based on the Adaptive Control of Thought—Rational (ACT-R) cognitive architecture (Anderson et al., 1998, 2004).

ACT-R aims to provide a general model of cognition (i.e. one that specifies higher-level perceptual and analytical processes of the human mind), that can be adapted for more specific purposes (Anderson et al., 1998, 2004) e.g. to understand interruptions. The ACT-R model is comprised of distinct processing modules relating, for example, to perceptual-motor tasks, factual memories, and goal tracking. Each module has its own 'buffer' module (Anderson et al., 2004). A central 'production system' involving a recurring cycle of events is posited to coordinate the modules, and in so doing, to adaptively control behaviour (i.e. to support goal completion).

Goal activation models based on ACT-R – which include the Associative Activation Model (Nowinski and Dismukes, 2005; Dismukes and Nowinski, 2007) and Memory for Goals theory (Altmann et al., 2002) – assert that the degree to which goals are active in memory most determines prospective remembering (the ability to remember tasks required in the future) – including the remembering of interrupted tasks (Altmann and Trafton, 2002; Dismukes and Nowinski, 2007).

Goals are considered 'active' while individuals are working on them – but activation is thought to decline over time. Being exposed to cues (i.e. objects associated with the goal) however is thought to 'reactivate' the goal – and hence to support remembering (Altmann and Trafton, 2002; Dismukes and Nowinski, 2007). This suggests that the duration of interruption (i.e. the period over which the primary task is suspended) might be crucial for remembering interrupted tasks – although any effect of duration may be moderated by individuals' exposure to cues (Grundgeiger et al., 2010; Li et al., 2012).

An important implication of goal activation models concerns individuals' performance of a familiar task, comprised of multiple subtasks. (All but the most basic of tasks can be considered to have multiple subtasks; Kirwan and Ainsworth, 1992). Each subtask, it is suggested, provides a cue to support remembering of the next subtask, hence many tasks might be viewed in terms of a chain of associative links (Altmann et al., 2002; Hodgetts and Jones 2005). Cues might also exist in the external environment, to the extent that cue-goal associations have been encoded in memory (Dismukes and Nowinski, 2007). All of this suggests that experience and practise on a task might make individuals more resilient to interruption i.e. because practise will strengthen the associative links among subtasks, making it easier to identify the next subtask in the sequence (Hodgetts and Jones, 2005; Li et al., 2012).

While a number of predictions of goal activation models regarding the effects of interruptions (or factors that might moderate such effects) were highlighted above, further such predictions are summarised under the headings below.

**More complex secondary tasks will impair primary task resumption.**

More subgoals are expected to be activated (through ‘associative cueing’) during complex secondary tasks, because such tasks tend to be comprised of a larger number of subtasks. When more subgoals are activated, it may be harder to select the appropriate one (Hodgetts and Jones, 2005; Li et al., 2012). Higher task demands might also interfere with individual’s ability to rehearse (i.e. to intentionally reactivate) the primary task (Monk, 2004).

**More complex primary tasks will hinder secondary task performance.**

The need to encode/ strengthen the primary task in memory suggests the potential for interference and deleterious effects (Dodhia and Dismukes, 2009; Hodgetts and Jones, 2005).

**Similarity of primary and secondary tasks will disrupt switching.**

Similar tasks will likely ‘activate’ similar goals, making it more difficult to select the appropriate one (Li et al., 2012; Wickens et al., 2012a).

**Interruptions occurring between *subtasks* will be less disruptive.**

There may be less information to recover, in order to resume the primary task, when interruptions occur between subtasks (i.e. between the end of one subtask and the beginning of another), compared to when they occur in the middle of a subtask (Monk, 2004). Also, because the timing of interruptions might effect how disruptive they are, the degree of control one has over this timing might also be important (McFarlane and Latorella, 2002; Monk, 2004).

Table 5-1 summarises the predictions made by goal activation theories regarding factors that moderate the effect of interruptions.



*Table 5-1 Predictions of goal activation theories regarding interruptions*

<b>Factors that facilitate primary task resumption:</b> <ul style="list-style-type: none"><li>• Shorter duration of secondary task</li><li>• Exposure to cues associated with the primary task during the secondary task</li><li>• The timing of interruption – and degree of control over this</li><li>• Rehearsal/ encoding during the interruption lag or secondary task</li><li>• Prior practise/ experience with a specific primary task</li><li>• Complexity of the secondary task</li></ul>
<b>Factors that impair secondary task performance:</b> <ul style="list-style-type: none"><li>• Complexity of the primary task</li></ul>
<b>Factors that impair switching among both primary and secondary tasks:</b> <ul style="list-style-type: none"><li>• Similarity of the primary and secondary task</li></ul>

## Summary and Evaluation

Goal activation models highlight some of the mechanisms involved in handling interruptions, and they might help to explain some of the Phase One findings. Regarding the latter point, the goal activation models might account for why experienced nurses were better at managing interruptions, and why nurses made reminders (i.e. cues), to support their prospective remembering of tasks. The finding that nurses often avoided immediate interruption – especially in the context of more ‘substantial’ tasks (e.g. more complex, or longer duration, tasks) – might also be better understood in light of these theories.

An important criticism of goal activation models however concerns their being based on a crude understanding of interruption (‘crude’ at least for those interested in real-world interruptions), similar to that described by the traditional account (see Literature Review Chapter). While the models imply that interruption is exclusively a problem of memory, Phase One, and other research (e.g. Latorella, 1999; Boehm-Davis and Remington, 2009; Colligan et al., 2012) emphasised that a wider range of cognitive processes, and strategic behaviours,

are involved in managing these events. This raises questions over the models' ability to predict the course of real-world interruptions – even if they can account for laboratory study findings.

#### ***5.1.1.3 The Effects of Interruptions, and Key Moderators***

Many of the predictions described above have been empirically tested. An overview of studies that have examined key moderators regarding the effects of interruptions is provided below.

##### **Interruption timing vis-à-vis primary task stage**

Several studies have compared the effects of interruptions occurring between subtasks to those arising when they occur within subtasks. The general finding of these studies is that between-subtask interruptions are less disruptive e.g. in terms of task completion times or error rates (Adamczyk and Bailey, 2004; Iqbal and Bailey, 2006; McFarlane and Latorella, 2002; Monk, 2004).

##### **Control over secondary task timing**

McFarlane (2002) compared four methods of imposing computer notification interruptions: an immediate approach, a negotiated method, a mediated method, and a scheduled approach. All methods resulted in impaired primary task performance, but the negotiated approach was the least impaired, and the scheduled method the most. Hodgetts and Jones (2003) found that subjects switched immediately half of the time when given control over interruption timing. Secondary, but not primary, task completion times were reduced when individuals had control, but no effect was observed on task resumption times.

### **Availability of cues and reminders**

Several studies of cue availability suggest these have a positive effect on interruption handling e.g. by reducing primary task resumption times (McDaniel et al., 2004; Altmann and Trafton, 2005; Trafton et al., 2005).

### **Primary-Secondary Task Similarity**

Studies of primary-secondary task similarity have produced inconsistent results. Oulasvirta (2004) found that text 'shadowing' tasks interrupted by other such tasks were more disruptive when the texts were similar, while Gillie and Broadbent (1989) reported that similarity led to decreases in primary task performance times. Other studies failed to establish an effect of similarity (Cellier and Eyrolle, 1992; Eyrolle and Cellier, 2000; Latorella, 1999). Speier et al., (1999) suggested that the lack of consistency in study findings might result from differences in how 'task similarity was defined and operationalised e.g. similarity on some task dimensions might be helpful, but on other dimensions it might be a hindrance.

### **Practice/experience**

Several studies suggest that interruption-related performance decrements are reduced when subjects are allowed to practise task switching (Cellier and Eyrolle, 1992; Trafton et al., 2003; Hess and Detweiler, 1994). Hess and Detweiler (1994) investigated whether this effect could be attributed to enhanced interruption management *per se*, or whether it derived from additional practise *on the primary task alone*. Their results suggested a benefit of practise only when individuals were able to rehearse switching among primary and secondary tasks (i.e. practising the primary task alone did not help).

Cades et al., (2011) replicated Hess and Detweiler's (1994) findings, and they conducted further research to establish whether practise effects derived from practising handling interruptions *in general*, or from practising switching among *specific primary-secondary task pairs*. Their findings supported the latter; only when subjects were able to practise switching among specific task pairs did their task resumption times improve.

### **Primary Task Complexity**

Czerwinski et al., (2000) and Eyerolle and Cellier (2000) both reported that primary task complexity was associated with impaired handling of interruptions, while Burmistrov and Lenova (2003) and Kreifeldt and McCarthy (1981) reported either mixed, or no substantive effects. Speier et al., (1999; 2003) found evidence for a bi-directional effect of interruptions on primary task performance, with enhanced performance on simple tasks, and impaired performance on complex ones. They explained this in relation to the effect of interruptions in increasing arousal. Heightened arousal was thought to facilitate performance in the context of simple tasks, but hinder it when the tasks are more complex (Speier et al., 1999; 2003). Ratwani and Trafton (2006b) examined this potential mechanism and reported some, albeit limited, evidence to support it.

## **Secondary Task Complexity**

Most studies of secondary task complexity suggest that this results in impaired performance. Four studies found that complex interruptions led to longer primary task resumption times (Monk et al., 2008; Cades et al., 2008; Hodgetts and Jones, 2005; Hodgetts and Jones, 2006)<sup>20</sup>, while a further study found that they were associated with higher error rates (Eyrolle and Cellier, 2000).

## **Secondary Task Duration**

Several studies have reported that longer interruptions have little or no effect on performance (Gillie and Broadbent, 1989; Bailey et al., 2000), however other studies have identified deleterious effects e.g. on primary task resumption (Hodgetts and Jones, 2006; Monk et al., 2008).

One possible reason for the lack of consistency in studies of secondary task duration relates to the potential for individual compensation after interruption. It has been suggested – and some evidence supports this idea – that people might compensate for interruptions by working faster (Altmann and Trafton, 2005; Zijlstra et al., 1999; Speier et al., 1999; 2003; Monk et al., 2008; Ratwani and Trafton, 2006a).

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<sup>20</sup> Note that a fifth study reviewed also supported the effect of task complexity on resumption times, although the tasks involved imposed either no demands at all (i.e. looking at a blank screen), or they imposed moderate demands (Monk et al., 2004). The study was excluded because it examined only a restricted range of complexity.

## **Summary and Evaluation**

The studies reviewed in this section shed light on the validity of the memory theories (goal activation models) examined in the previous section. Overall, the research suggests that the theories may be useful in understanding interruptions' effects, although several of the hypotheses (e.g. regarding task similarity, task duration) received only limited support. It should be noted however that the vast majority of studies were conducted in artificial settings, and involved contrived scenarios based on a 'traditional account' view of interruption. It is not clear therefore, to what extent the findings might generalise to real world settings, where task switching behaviour might be more complex – and where memory might be just one of a number of processes involved in handling interruptions (e.g. as per the Phase One study).

As well as illuminating the validity of the memory theories, the studies also highlight additional factors implicated in the course of (or in the outcome of) interruptions. For example, they shed light upon specific conditions under which practise facilitates interruption handling, and they also suggest that people might take steps to compensate for any adverse effects of interruptions (e.g. on individual productivity). Having an improved understanding of how practise facilitates interruption handling might be important since it could lead to the development of interventions (e.g. involving training) that enable improved task management – and provide greater resilience to (potential) adverse effects of interruption. Knowledge of potential compensation effects might also be helpful since this highlights the complexity of interruptions and the difficulties involved making causal attributions regarding these events (i.e. since compensation

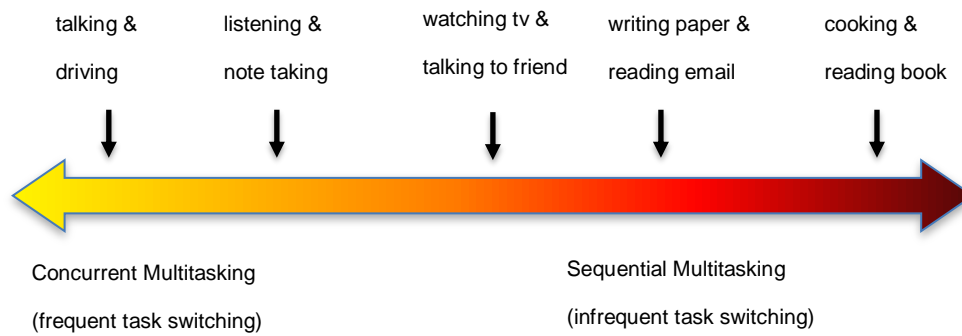
effects imply that interruptions might simultaneously have both positive and negative effects).

That individuals might learn to better handle interruptions, and take measures to compensate for their effects, also fits with one of the key themes of Phase One – individuals' ability to adapt vis-à-vis competing demands.

### **5.1.2 Multitasking**

Two concepts that help to illuminate the relevance of multitasking vis-a-vis interruptions include the Multitasking Continuum (Salvucci and colleagues, 2009; 2011b) and Wickens et al's (2012b; 1999) two fundamental ways of allocating attention.

The Multitasking Continuum (Salvucci et al., 2009; 2011b; Figure 5-2) suggests that simultaneous behaviour can be viewed on a 'task switching frequency continuum', with infrequent switching (or Sequential Multitasking) – such as that observed during 'interruption' – at one end of the spectrum, and frequent switching (or Concurrent Multitasking), at the other. Concurrent Multitasking is thought to involve the kind of task switching behaviour that can be measured in sub-seconds (e.g. talking while driving), while Sequential Multitasking refers to switching that may be more appropriately-measured in minutes and hours (e.g. cooking while reading a book). (The additional examples of multitasking activities included in Figure 5-2 were taken from Salvucci et al., 2009).



*Figure 5-2 The multitasking continuum*

Wickens et al's (2012b; 1999) two fundamental ways of allocating attention among a set of tasks were 'graded allocation' (also called 'time sharing') and 'all-or-nothing' (also called 'time swapping'). Graded allocation refers to situations where people perform two or more tasks simultaneously, and divide resources strategically between them (e.g. they might devote 60% to task 1 and 40% to task 2). All-or-nothing allocation describes scenarios in which individuals switch frequently between tasks (e.g. they might perform task 1 for 30 seconds, then task 2 for 10 seconds, then task 1 again for 20 seconds etc), a behaviour which might resemble multitasking in certain circumstances (Czerwinski et al., 2004; Loukopoulos et al., 2009; Hardy and Gillan, 2012; Wickens et al., 2012b). Such circumstances include where individuals switch among multiple, ongoing tasks, completing just part of the task each time – just as a circus 'plate-spinner' moves back and forth between plates, in order to keep them all spinning.

Both of these models highlight the conceptual overlap between interruptions and multitasking, and they suggest ways in which research on these two phenomena might be integrated. The sections below consider 1) applied studies of



multitasking, and 2) more theoretical research regarding the cognitive basis of concurrent performance.<sup>21</sup>

### ***5.1.2.1 Applied Studies of Multitasking***

#### **Healthcare research**

As noted previously, a number of healthcare interruptions studies also examined multitasking (Coiera et al., 2002; Hillel and Vincente, 2003; Drews, 2007; Collins et al., 2007; Laxmisan et al., 2007; Westbrook et al., 2008; Grundgeiger et al., 2010; Kalisch and Aebbersold, 2010; Berg et al., 2012; Colligan and Bass, 2012; Walter et al., 2013). While these studies were summarised in the Literature Review Chapter, the focus there was on interruptions and it is helpful to consider their contribution vis-à-vis healthcare multitasking specifically. (The interruption handling studies were excluded since their results regarding multitasking were discussed in detail in Phase One: Hillel and Vincente, 2003; Drews, 2007; Collins et al., 2007; Grundgeiger et al., 2010; Colligan and Bass, 2012.)

Westbrook et al., (2008) reported that doctors and nurses spent about 1/5 of their time multitasking, while Kalisch et al., (2010) found that nurses spent 1/3 of their shift engaged in such behaviour. No evidence of an association between multitasking and errors was apparent in the latter study – although the clinical environment was characterised as being “conducive to mistakes” (Kalisch et al., 2010).

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<sup>21</sup> The distinction between these two literatures represents a significant simplification; theoretical research has often drawn on real-world studies, while applied studies have been inspired by theory. However the distinction is helpful because multitasking has tended to be conceptualised, and studied, in different ways by those concerned primarily with theory versus application (Salvucci and Taatgen, 2011a, p13).

Berg and colleagues (2012) found that nurses multitasked frequently – more so than doctors – and especially during information exchange. Walter et al., (2013) recorded that ward staff – both doctors and nurses – spent just under 10 minutes per hour multitasking, compared with 14 minutes for emergency doctors. Coiera et al., (2002) found that emergency doctors and nurses spent 10% of communication time involved in simultaneous conversations.

Laxmisan et al., (2007) found that clinicians spent more time multitasking than performing any one specific task, in the context of shift handovers. The need for clinicians to keep track of, and to prioritise, multiple outstanding tasks meant that multitasking was essential, however the cognitive load faced by clinicians as a result was very high.

The remaining studies in this section were not included in the Literature Review Chapter, but all examined healthcare multitasking.

Mache et al., (2011a) examined cardiologists' workload in German hospitals. Doctors had high workloads and spent 16% of their time multitasking. A similar study of psychiatrists' workloads reported that doctors spent 10% of their time multitasking (Mache et al., 2011b).

Van Renson and colleagues (2012), and Groen et al., (2010) describe studies in which intensive care handovers were video recorded, to establish how often clinical equipment was handed over at the same time as patient information. This type of 'multitasking' occurred in a majority of cases.

Koh et al., (2011) investigated how scrub nurses managed their attention while multitasking during caesarean surgeries. They found that nurses attended most to the parts of the human body, or areas in the environment, most critical to the success of the operation. Experienced nurses allocated attention most 'optimally' (i.e. they looked at the 'highest value' areas the most), and they encountered fewer unexpected tasks at critical times. This suggests that experience (via appropriate attention allocation) reduced the incidence of unexpected tasks – or alternatively, that experienced nurses were less likely to allow interruptions at critical times.

Franklin et al., (2011) investigated physicians' task switching decisions in an emergency setting using ethnographic observations. Data regarding physicians' task switching were coded to learn about the main drivers of doctors' behaviour. The results identified three main types of task transition: planned (45% of decisions), opportunistic (34%), and 'break in task' (21%). Planned transitions involved moving to the next logical subtask (in a task comprised of multiple, related subtasks). Opportunistic switching entailed taking advantage of unexpected opportunities to perform tasks (e.g. a doctor happens to see a patient he wanted to speak to). 'Breaks in task' generally related to unplanned activities imposed by external forces (e.g. responding to an urgent patient need). Some 'breaks in task' required the suspension of a current task while others involved multitasking of the original and unplanned activities.

### **Aviation studies**

Raby and Wickens (1990; 1994) conducted several experiments to examine how pilots scheduled and prioritised tasks in situations such as simulated landing

approaches.<sup>22</sup> Under conditions of higher workload, pilots performed tasks in order of priority, and some low priority tasks were dropped altogether (i.e. they were removed from a mental list of tasks; Raby and Wickens, 1990). Pilots' prioritising became more efficient with practise (Raby and Wickens, 1990). High performing pilots scheduled discrete tasks earlier, and shifted between activities more frequently, suggesting better planning and monitoring (Raby and Wickens, 1994). None of the participants however planned task sequences in great detail, as doing so would have demanded huge cognitive resource (Raby and Wickens, 1994).

Loukopoulous et al., (2003) drew on incident reports, and conducted extensive observations, in their study of pilots' multitasking. Pilots frequently had to perform tasks concurrently, and that they faced a wide variety of distractions. Pilots performed complex cognitive operations to interleave, suspend and defer tasks strategically, while they frequently executed novel tasks alongside routine and well-practised ones. This was a concern because novel task combinations may be particularly vulnerable to error. Another significant challenge concerned the need for pilots to monitor ongoing tasks – and the environment more generally – while concurrently performing other activities (i.e. monitoring was seen to be 'multitasked' with other jobs). This behaviour was thought to help pilots to avoid becoming engrossed in one activity, to the detriment of others – however, retrieving intentions (e.g. remembering to resume interrupted tasks) in situations where no cues were available was considered hazardous.

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<sup>22</sup> Note that the three papers cited here are based on the same data.

Bellenkes et al., (1997) examined patterns in visual scanning of novice and expert pilots, in a simulation study. Experts adapted their scanning behaviour more flexibly in response to changing demands, and they focused more on 'higher value' events (those most likely to be problematic if not addressed). This suggests, according to the researchers, that experts are better at determining where and when to look for relevant information, and may be superior in anticipating future events.

### **Organisational studies**

Gonzalez and colleagues (2004) observed how IT professionals organised their work, in order to understand how technology might be designed to support this. Individuals were found to structure their work not solely in terms of distinct tasks, as is often assumed, but according to larger themes or 'spheres' of activity. Fragmentation and discontinuity was a feature of the work for all of the groups studied, and individuals had 10 spheres of work running concurrently, on average.

Polychronicity, an enjoyment of, or willingness to engage in, multitasking, has been examined in a number of organisational studies (Waller, 2007; Conte et al., 1999). While apparently related to time urgency, it might be driven more by an enjoyment of variety than a desire to 'beat the clock' (Conte et al., 1999). Studies suggest that the fit between individuals' 'polychronic outlook', and the specific demands of their work, has important implications for wellbeing (Arndt et al., 2006; Slocombe and Bluedorn, 1999) and perceptions of performance (Slocombe and Bluedorn, 1999; Conte and Gintoft, 2005).

## Summary and Evaluation

The aims, tasks, and methods used to study multitasking in applied research varied tremendously, while multitasking was conceptualised and operationalised very differently by researchers. This suggests the absence of a clear, shared understanding of what multitasking actually entails, and it makes it difficult to meaningfully synthesise the study results. Nevertheless, taken as a whole, the studies imply that people working in real-world settings act strategically to support task management – a finding that is consistent with the Phase One study. In fact, a number of the specific adaptive strategies that were highlighted in applied multitasking research bear close resemblance to strategies identified in Phase One. For example, the role of planning and prioritising (Raby and Wickens, 1990, 1994; Bellenkes et al., 1997; Loukopoulous et al., 2003; Laxmisan et al., 2007; Grundgeiger et al., 2010; Colligan and Bass, 2012), strategic attention management and monitoring (Bellenkes et al., 1997; Koh et al., 2011; Raby and Wickens, 1990, 1994; Bellenkes et al., 1997; Loukopoulous et al., 2003; Grundgeiger et al., 2010), and grouping activities together to facilitate performance (Gonzalez et al., 2004), were all recognised in Phase One – as was the notion that individuals were ‘opportunistic’ as well as strategic in their multi-task management (Frankin et al., 2011). (Note that opportunism was described as ‘reacting’ in Phase One.) All of this further supports the assertion that interruptions and multitasking may be conceptually similar.

One strategy not identified in Phase One, but which might be relevant, concerned changing performance requirements dynamically (e.g. by dropping tasks from a ‘to do’ list) in response to an increased workload (Raby and Wickens, 1994; Loukopoulous et al., 2003).

### **5.1.2.2 Theoretical, Cognitive Multitasking Research**

Cognitive multitasking research is usually grounded in theory relating to the underlying mental processes involved in multitasking – and it tends to be take place in artificial settings. A number of distinct theories and research paradigms can be identified (Meyer and Kieras, 1997; Salvucci et al., 2009; Wickens et al., 2015). Research from each of the following five areas is examined below: 1) automaticity research 2) bottleneck theories, 3) general multitasking capacity accounts, 4) multiple resource models, 5) executive control and task switching.

#### **Automaticity Research**

Studies have demonstrated that practise allows tasks to be performed more automatically, requiring fewer resources. Under certain scenarios, near-complete automaticity can be achieved, meaning that multiple tasks can be performed concurrently without decrements in task performance (Shiffrin and Schneider, 1977; Fisk et al., 1982). The main feature of the said scenarios is consistency e.g. in the circumstances in which practise occurs (Shiffrin and Schneider, 1977; Schneider and Chein, 2003; Logan, 1992). Where task demands are high however, automaticity – and hence smooth concurrent performance – may be impossible (Kahneman, 1973; Rubinstein et al., 2001).

#### **Bottleneck Theories**

Several different types of bottleneck have been proposed, relating to functions like perception and response selection. Broadbent's (1958) perceptual bottleneck theory posited the existence of a filter that identified salient object features, and filtered out irrelevant ones (i.e. to maximise perceptual insights given the limited capacity of the central channel). While some experiments supported this idea

(Broadbent, 1958; Wood and Cowan, 1995), others challenged it. One study showed that participants processed information about the sound and meaning of concurrently-presented words that they had been encouraged to ignore – suggesting individuals were unable to ‘filter out’ irrelevant information (Treisman, 1964).

### **General Multitasking Capacity Models**

General capacity models share with bottleneck theories the belief that multitasking is limited by central processing – but unlike bottleneck theories they view cognition as fundamentally set up for multitasking (Kahneman 1973; Wickens, 1991). They also maintain that attention can be allocated flexibly across tasks, to support efficient working (Meyer and Kieras, 1997; Gopher et al., 1982; Wickens, 1991).

Evidence that attention can be allocated flexibly was obtained by studies that demonstrated individuals’ ability to dynamically reprioritise in a dual-task scenario (Gopher et al 1979; Gopher et al., 1982). However, not all research supports general capacity theories, and they fail to explain *how* resources might be reallocated dynamically (Gopher et al., 1982; Wickens et al., 2012b).

### **Multiple Resource Theories**

Multiple resource theories integrate bottleneck and general resource models. They assert that multitasking ability is restricted by competition for multiple, limited resources, but they maintain that attention can be allocated flexibly across tasks, to maximise performance (Gopher et al., 1982; Wickens, 1991; Wickens and McCarley, 2008b). Where two or more tasks in a multi-task set depend



heavily on one of the limited resources, the theory predicts interference (Navon and Gopher, 1979; Gopher et al., 1982; Wickens, 1991).

The multiple resource model described by Wickens (2008b; 2012a) – depicted in Figure 5-3 – suggests the resources involved in multitasking can be distinguished along four dichotomous dimensions, relating to the 1) stage of processing, 2) the type of processing, 3) the perceptual modalities, and 4) specific visual channel limitations. More details of the first three of these is provided below.<sup>23,24</sup>

### *Stage of Processing*

Perceptual tasks and general cognitive activities (e.g. using working memory) are thought to occur at a different ‘stage’ of processing than response selection and execution (Wickens and McCarley, 2008b; Wickens et al., 2012b). Linguistic studies showing that language processing (e.g. reading) occurs at a different stage to language production (e.g. speaking) support this idea (Wickens, 2012a).

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<sup>23</sup> The fourth was omitted because it is considered a less critical dimension (Wickens, 2002).

<sup>24</sup> Other multiple resource theories include computational cognitive models based on ACT-R e.g. Threaded Cognition (Salvucci and Taatgen, 2008; Salvucci and Taatgen, 2011a) and Executive Process Interactive Control (EPIC) (Meyer and Kieras, 1997).

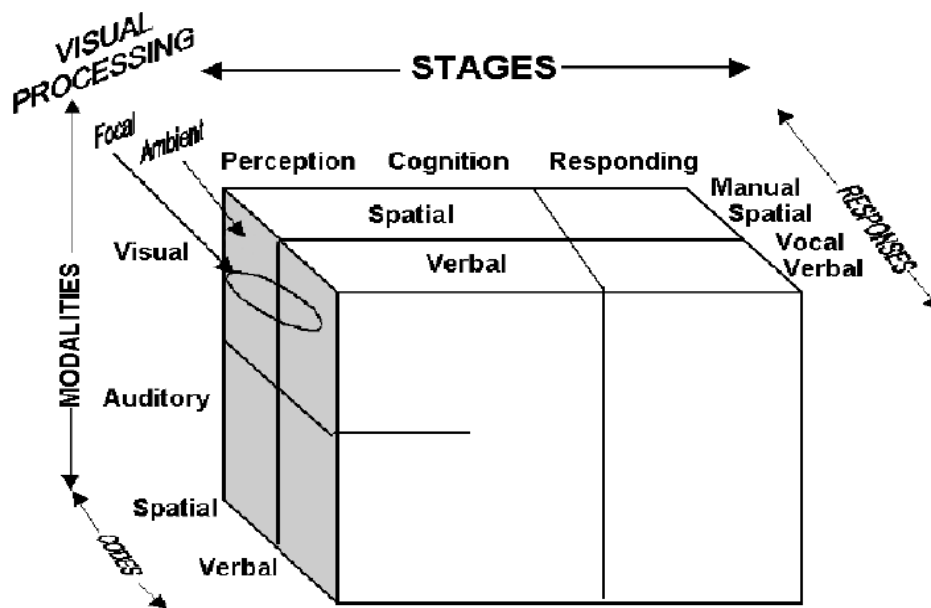


Figure 5-3 Four dimensions of 'demand multiplicity' in Multiple Resource Theory

### *Type of Processing*

The main 'types' of processing relate to analog/spatial or linguistic/verbal processing (Wickens and McCarley, 2008b; Wickens et al., 2012b). Research suggests that spatial and linguistic tasks can be managed concurrently to quite a large extent (Sarno, 1995).

### *Perceptual Modalities*

Visual and auditory resources are thought to be functionally separate, meaning that a task involving visual discrimination (e.g. tracking the movements of the cursor/arrow on a computer) might be performed concurrently with one that depends on auditory capacities (e.g. listening to a colleague). However, performing two (or more) tasks that rely on the same modality may be more difficult (Wickens and McCarley, 2008b; Wickens et al., 2012b). Wickens and McCarley (2008b) point to several studies of concurrent data processing that support the distinction of perceptual modalities.

Multiple resource theories help to explain findings – for example regarding peoples' ability to manage some task-sets, but not others, concurrently, that other theories could not (Navon and Gopher, 1979; Gopher et al., 1982; Wickens, 1991). Moreover, the ability of Wickens et al's (2008b; 2012a) model to predict between-task interference, in real-world settings, has been established (Sarno, 1995; Wickens, 2008). Despite this, multiple resource theories have been criticised for the lack of specificity regarding the cognitive mechanisms that lead to interference (Meyer and Kieras, 1997; Salvucci and Taatgen, 2011b). In addition, the models do little to explain *how* resources might be reallocated dynamically.

### **Executive Control and Task Switching**

Executive control refers to the higher-level cognitive processes involved in the regulation and control of goal-directed action. Key aspects of executive control include the supervision of attention, and the activation or inhibition of schemas (Norman, 1986; Miyake et al., 2000). In the context of multitasking, the role of the executive system might involve reallocating attention to different tasks, prioritising tasks, and initiating and terminating jobs (Baddeley, 1986; Rubinstein et al., 2001; Miller and Cummings, 2007).

Many studies of executive control and multitasking used a paradigm described simply as “task switching”, in which participants complete a series of trials which require them to either: 1) to switch mental operations from one task to the next, or 2) to repeat the same operation over and over (Trafton and Monk, 2007; Wickens and McCarley, 2008a). The main finding of “task switching” studies concerns clear evidence of a ‘switching cost’ (Allport et al., 1994; Rogers and Monsell,

1995; Monsell, 2003). Costs are exacerbated in the context of complex tasks (Rubinstein et al., 2001), but are mitigated through practise (Rogers and Monsell, 1995; Monsell, 2003).

The best supported explanations for switching costs include 'Task Set Reconfiguration' and 'Task Set Inertia'. Task Set Reconfiguration refers to the need for individuals to re-think the 'rules of a task' i.e. to retrieve relevant information, and reorient to a new goal (Monsell, 2003). Task Set Inertia concerns the appropriate activation of 'procedural rules' for the new task – and the inhibition of inappropriate ones (Allport et al., 1994; Wickens and McCarley, 2008a).

While task switching studies highlight potential mechanisms underlying difficulties in multitasking, a particular concern relates to the degree to which switching costs can be attributed to executive functions. It seems likely that processes beyond the executive system – for example relating to memory – might contribute to switching costs, making it difficult to interpret study findings (Logan, 2003; Arrington and Logan, 2004; Hardy and Gillan, 2012).

## **Summary and Evaluation**

Multitasking was defined more narrowly and precisely in theoretical, cognitive research when compared with applied studies, while the aims adopted by the former were more consistent (i.e. almost all cognitive studies examined the limits of multitasking ability, and investigated the degree of interference associated with this behaviour, for a given task set). The reason for this difference may be that while cognitive researchers were concerned to measure discrete aspects of

cognition as accurately as possible, and attempted to eliminate the effects of context, applied researchers were often interested in how individuals adapted to context (hence variability in the context was considered in positive, rather than negative, terms; Salvucci and Taatgen, 2011b; Wickens et al., 2015).

Significant questions can be raised regarding the extent to which the findings of cognitive multitasking studies might generalise to real-world settings. The tasks performed in these studies are often arbitrary and tend to be simpler than everyday activities (Hardy and Gillan, 2012; Panepinto, 2010). In the context of task switching studies specifically, participants were *forced* to switch and they could not be strategic about how and when they did this – as they may be in the real world (e.g. see Phase One; and also Loukopoulous et al., 2003; Hardy and Gillan, 2012). Of the various theories/ approaches described, the vast majority rely on laboratory research to support their contentions, and only Wickens et al's (2008b; 2012a) multiple resource model has been used extensively to predict real world performance (Sarno, 1995; Wickens, 2008).

While cognitive multitasking studies were very different to the Phase One research – and to the applied multitasking studies – there were two key points upon which all of the literatures agreed. First, the Phase One study, like the cognitive multitasking research, identified significant limitations on individuals' handling of competing demands. Second, the claim that individuals can allocate their attention flexibly in the context of multiple tasks is also consistent with Phase One.

As well as agreeing on certain points, the cognitive multitasking research might help to explain key findings of Phase One. Research regarding automaticity, for

example, might help to explain why experienced nurses' were better able to handle interruptions. Studies of task switching furthermore, might shed light on why nurses often avoided interruptions in Phase One (e.g. because there are limits on multitasking ability, and multitasking might have costs compared with performing tasks in serial, one-at-a-time). Finally, the notion of executive control helps to illustrate why interruptions and multitasking may be considered similar phenomena. Both involve cognitive processes to prioritise activities, and to initiate and terminate tasks, to give just two examples.

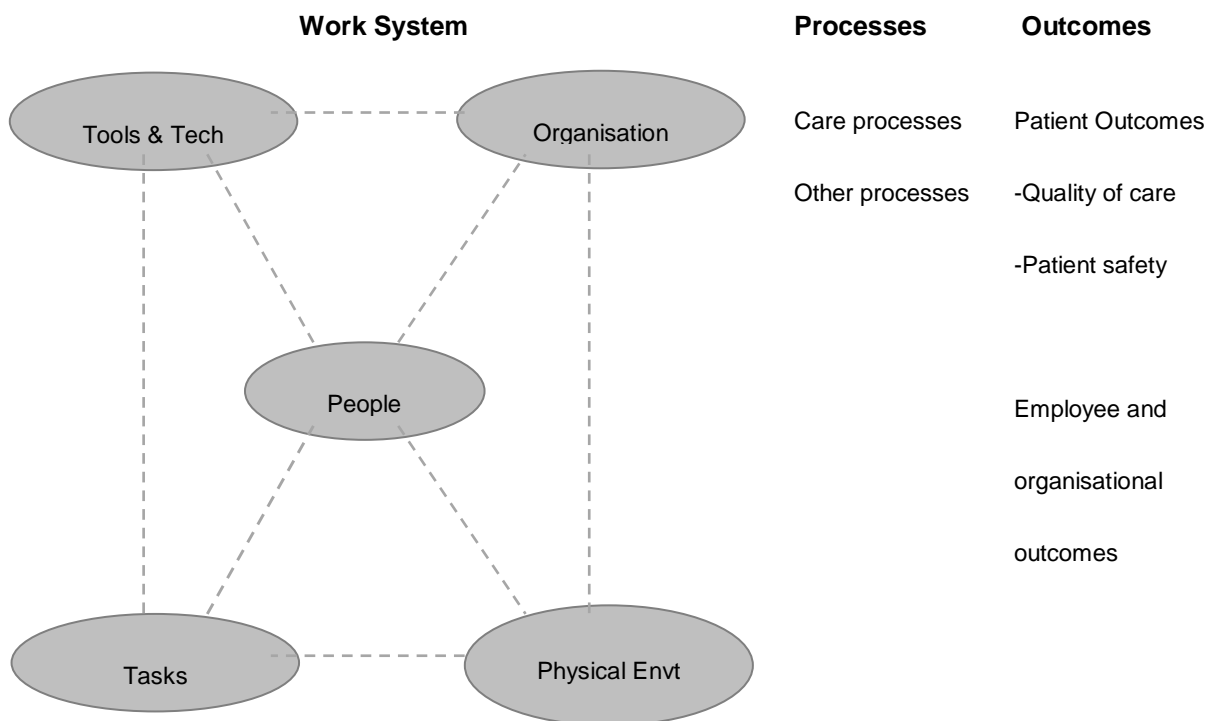
### **5.1.3 The Nature of Dynamic Healthcare Work**

Two specific areas of research were examined to support learning regarding the nature of complex and dynamic healthcare work. These included research relating to: 1) sociotechnical systems, and 2) the nature of cognition and adaptation vis-à-vis complex and dynamic work.

#### ***5.1.3.1 Sociotechnical Systems (STS)***

Sociotechnical systems (STS) approaches emerged from the work of researchers at the Tavistock Institute in the 1950s (Trist, 1981). They emphasise the need to consider the dynamic interactions and mutual influences among social and technical subsystems in a work environment (Trist, 1981; Fox, 1995). Social subsystems comprise various 'people elements' (e.g. behaviours, skills, beliefs, relationships), while technical subsystems consist of tools, processes and aspects of the physical environment (Fox, 1995; Berg et al., 2003). To understand the sociotechnical system, researchers must investigate both the individual subsystems, and their interactions with other subsystems (Fox, 1995; Trist, 1981).

The Systems Engineering Initiative for Patient Safety model (SEIPS; Carayon, 2006) represents a sociotechnical model of healthcare systems. The model describes how patient safety – and other healthcare outcomes – emerge through the interaction of different components of the healthcare system. As shown in Figure 5-4, the model comprises three main elements: 1) work system, 2) processes, and 3) outcomes.



*Figure 5-4 SEIPS model of work system and patient safety (adapted from Carayon, 2006)*

Work systems are made up of people (patients and healthcare professionals), tools and technologies, tasks, the physical environment (e.g. layout, design, noise etc) and work organisation (e.g. teamwork, coordination, communication, culture, relationships). People are placed at the centre of the work system since

they are the main agent of healthcare work. (Note here that patients and carers, as well as clinicians, are considered part of the 'system'.)

Work processes include not only care processes, but also the wide range of activities that support care (e.g. cleaning, maintenance). Processes are seen to be shaped by the work system components since it is people performing tasks, using tools, in a physical environment, that ultimately enact processes. Healthcare outcomes are described for all of the main stakeholders in the system i.e. patients, employees, and healthcare organisations.

SEIPS has been criticised by a number of researchers – in particular because the model implies quite a static view of what would seem to be a very dynamic system (Holden et al., 2013). Despite this, the model helps to provide a structure for understanding findings from studies such as Phase One, where multiple aspects of the healthcare system are found to contribute to a phenomenon.

### ***5.1.3.2 Cognition and adaptation in dynamic settings:***

#### ***Macro cognition***

The concept of macrocognition provides a useful way to understand how people adapt to complex and dynamic work environments. It describes the higher-level cognitive functions that people use to navigate challenging, real-world environments – as opposed to the narrow and discrete ('microcognitive') processes which tend to be studied by cognitive researchers, in laboratory settings (Klein et al., 2003; Schraagen et al., 2008). Work in most real-world environments, according to Klein et al., (2003), requires the use of a range of macrocognitive functions, which must be combined, in clever and careful ways, to



facilitate goal achievement. To understand how even relatively basic jobs are done, therefore, requires the naturalistic study of higher-level thinking processes (Klein et al., 2003; Schraagen et al., 2008).

The Macro cognition Framework (Klein et al., 2003; Schraagen et al., 2008), depicted in Figure 5-5, and described in Table 5-2, represents one attempt at describing the specific higher-level cognitive functions that people use to manage the demands of dynamic work. Klein et al., (2003; 2008) distinguish in their framework between macrocognitive functions and macrocognitive processes. The processes are considered subservient to the functions, since the former help to support the activities performed by the latter.

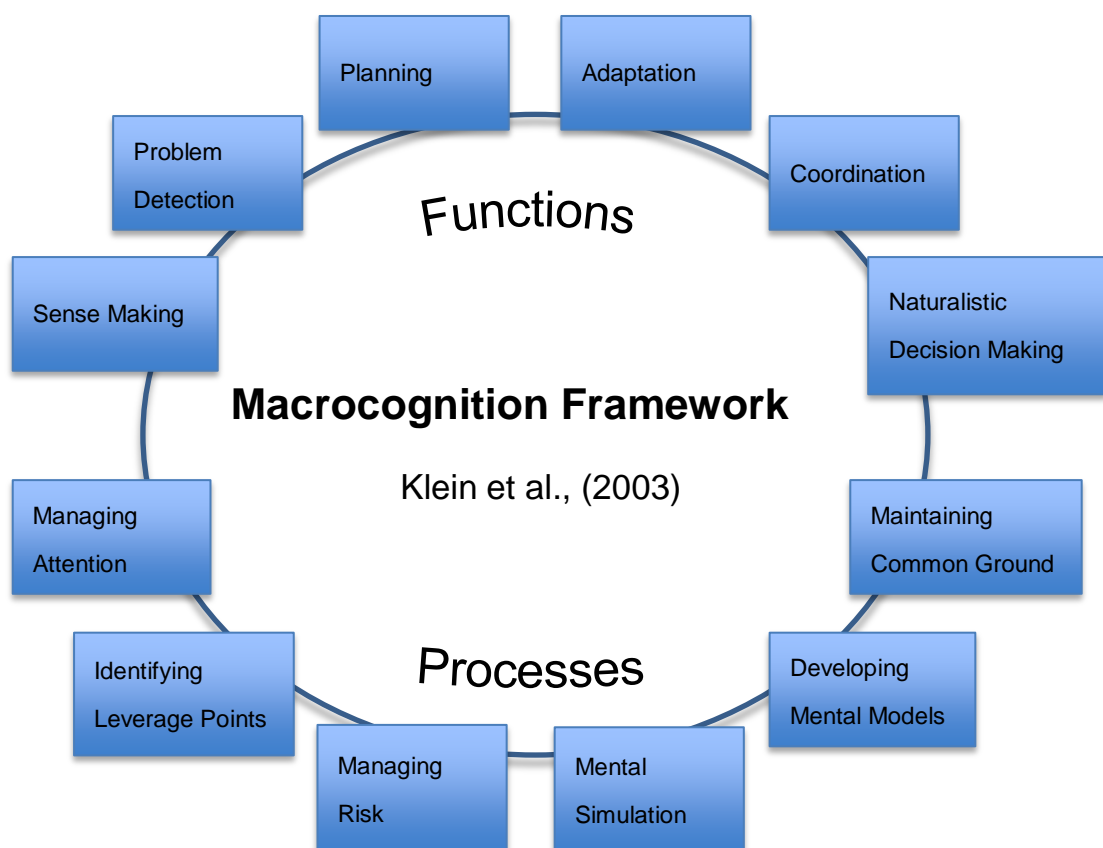


Figure 5-5 Macro cognition framework

Another important feature of the model is that it can apply not only to individuals' work, but also to the work performed by a team or a system (Klein et al., 2003; Schraagen et al., 2008). Hence Patterson and Hoffman (2012) describe Macroognitive Work Systems, which are said to be similar to sociotechnical systems, but with an additional emphasis on cognition.

*Table 5-2 Macroognitive functions and processes in the macrocognition framework*

Macroognitive Functions
<ul style="list-style-type: none"> <li>• <b>Sensemaking.</b> Used to understand how the current situation came about, and to anticipate ways in which the situation might evolve</li> <li>• <b>Problem Detection.</b> Entails spotting problems or anomalies at an early stage (e.g. while they might still be rectified).</li> <li>• <b>Planning.</b> Involves modifying an action to transform a current state into a desired future state.</li> <li>• <b>Adaptation.</b> Involves goal negotiation. Some tasks may be dropped and others reprioritised.</li> <li>• <b>Coordination.</b> Used to orchestrate the sequencing of actions in a team</li> <li>• <b>Naturalistic Decision Making.</b> Involves the swift identification of an adequate course of action, based on experience, or Recognition Primed Decision making. This view of decision making contrasts with classical accounts, which posit that individuals are exhaustive in comparing all potential options available to them.</li> </ul>
Macroognitive Processes (support Macroognitive Functions)
<ul style="list-style-type: none"> <li>• <b>Managing attention.</b> Using perceptual filters to attend to information, and cues in the environment, that help to reduce the difficulty of cognitive work</li> <li>• <b>Identifying leverage points.</b> Identifying opportunities to change the course of events.</li> <li>• <b>Managing risk.</b> Reasoning strategies that help deal with uncertainty.</li> <li>• <b>Mental simulation.</b> Using mental models to project into the future.</li> <li>• <b>Developing mental models.</b> Building understanding of the dynamics of a system, or some other complex phenomenon.</li> <li>• <b>Maintaining common ground.</b> Developing shared concepts to support communication and a shared understanding within a team.</li> </ul>

## Summary and Evaluation

In summary, both the SEIPS model and the Macro cognition Framework shed more light upon the Phase One findings. It might be suggested, based on SEIPS, that the 'context factors' that interacted to produce complexity and dynamism – and which ultimately created the need for interruption in Phase One – might be reinterpreted vis-à-vis the healthcare system. (In other words, it was not just the 'context' that produced interruptions, it was the healthcare system itself.) Similarly, the finding that nurses used the context to support handling interruptions might be reinterpreted in terms of their using the healthcare system to manage these events.

The concept of macro cognition helps to explain why nurses were found, in Phase One, to combine multiple high level strategies to handle interruptions (i.e. because complex work requires individuals to combine such strategies, to successfully manage the substantial cognitive demands). The Macro cognition Framework (Figure 5-5) is also helpful because it provides a structure for examining specific strategies that people use to handle complexity. Several of the strategies (e.g. planning, managing attention) were found to be important in Phase One, while several others (e.g. sensemaking, problem detection) bear resemblance to behaviours that were described.

A final point regarding macro cognition concerns methodology. The macro cognition concept points to the need to study phenomena in a naturalistic way e.g. by examining events in their natural (i.e. real world, not artificial) settings, using methods that capture their richness and complexity. This is consistent with the general approach adopted by the current doctoral research (see Research Design and General Method chapter).

## 5.2 PART TWO: CONCEPTUAL FRAMEWORK OF INTERRUPTIONS AND COMPETING DEMANDS

The current section presents a conceptual framework for understanding interruptions, and related concepts, based on the findings from Phase One and the results of the literature review presented in part one. The framework comprises two models – a model of interruption handling, and a model of the role of the healthcare context in shaping interruptions – as well as a set of definitions.

### 5.2.1 Model of Interruption Handling

Figure 5-6 presents a new model of interruption handling in the context of unplanned tasks.<sup>25</sup> The model suggests that managing interruptions involves three distinct stages (hence the name ‘Three Stage Model’), all of which draw heavily on individual experience.

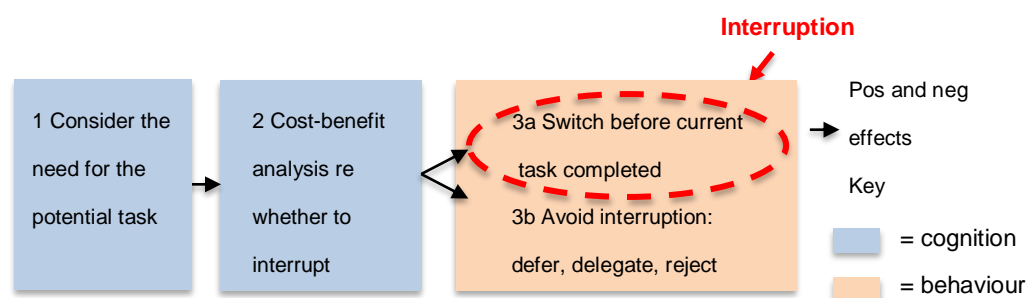


Figure 5-6 Three stage model of interruption

**Stage 1:** consideration is given regarding the need for a potential task (i.e. whether the task would contribute to the achievement of a clinical goal).

This process (of consideration) may be prompted by an obvious external

<sup>25</sup> The current model relates primarily to interruption in the context of unplanned tasks. Interruptions that were voluntary or self-initiated might not be well accounted for.

cue in the environment, by associative activation (e.g. a routine where one task is often performed after another), through planning or unprompted remembering, by a request from a patient or colleague, or through the use of a tool or artefact of some kind (e.g. a 'to do' list of outstanding tasks, or an electronic reminder). Consideration of the importance and urgency of the potential task, relative to other outstanding jobs (i.e. prioritising), is thought to begin at this stage. The stage culminates in the forming of an intention to perform the task – or if the job is obviously too low on the list of priorities, it will be rejected.

**Stage 2:** if the task is not rejected at stage 1, a cost-benefit analysis is performed regarding whether or not to interrupt the current task, or to avoid interruption (e.g. by deferring, delegating or rejecting the task). This will involve brief consideration of the impact of interruption on the current task – but also in terms of competing demands i.e. the other planned and unplanned tasks on the nurses' 'to do' list, and the social, organisational and clinical constraints of the context. Prioritising, planning and anticipating the potential course of events are thought to be involved in estimating the likely 'costs' and 'benefits' of different handling approaches. Also, since the relative merits of competing tasks continue to be evaluated in stage 2, this presents a further opportunity to reject the unplanned task (or other tasks on the 'to do' list).

**Stage 3:** if the outcome of the cost-benefit analysis was a decision to interrupt, then this will be enacted. (This is the behavioural stage of the three stage model; the first two stages are characterised primarily by

cognitive activity).<sup>26</sup> It should be emphasised that it is *the act of switching*, before the current task is finished, to another task, that is considered ‘interruption’. No assumptions are made, for example, regarding whether/ how the secondary task is completed – or whether/ how the primary task is resumed.<sup>27</sup>

Efforts might be made prior to interruption to plan for, or to support the later remembering of, the interrupted task e.g. by writing a reminder note, by placing a relevant object in a prominent place, or by completing a current subtask. A similar process might occur where an unplanned task is deferred for a period.

Individual experience is thought to be crucial in all stages of the Three Stage Model, since it provides a better basis for: 1) evaluating the relative importance and urgency of tasks (stage one), 2) appreciating the likely costs and benefits regarding whether – and how – to interrupt (stage two), and 3) switching tasks in a smooth manner (stage three). Such is the importance of experience, it might allow any – or all – of the stages to be performed ‘automatically’ i.e. with minimal conscious effort. Individuals might recognise common task scenarios, and remember how these were handled previously, as suggested by Boehm-Davis and Remington (2009).<sup>28</sup>

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<sup>26</sup> The distinction between cognitive and behavioural activities highlights the *primary* activity at each stage. Each might, in reality, involve combining cognition and behaviour e.g. in considering the need for a task (stage 1), a nurse might perform a behaviour e.g. she might ask a colleague whether he has already done the task.

<sup>27</sup> This distinguishes the current definition from most extant accounts of interruption, which conflate the act of switching with the handling of the secondary task.

<sup>28</sup> Boehm-Davis and Remington (2009) derived this idea from the Recognition Primed Decision Model described by Klein (1993; 2008).

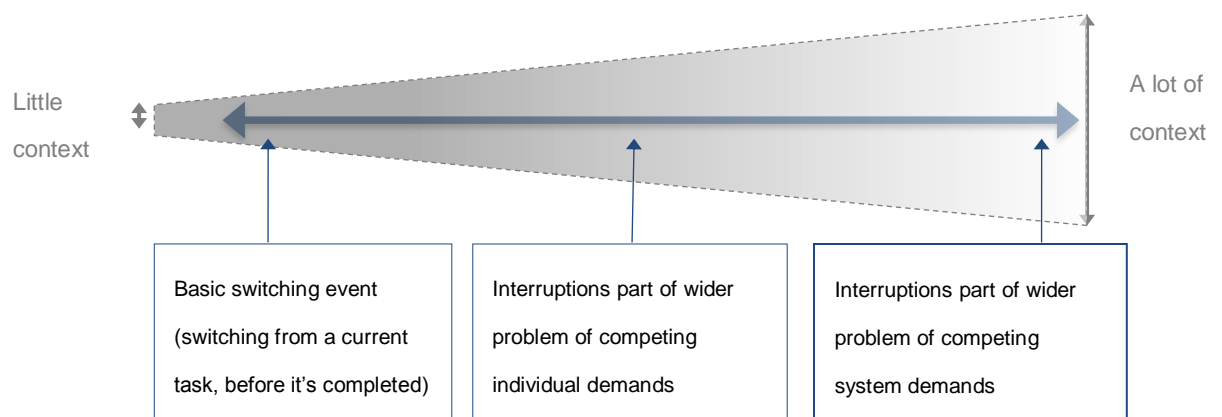
In terms of the effects of interruptions, both positive and negative effects are thought possible, reflecting the complexity of these events.

Two caveats should be borne in mind in interpreting the Three Stage Model. First, the model might not apply in the context of quick and straightforward unplanned tasks since the effort involved in evaluating whether/ how to interrupt might be greater than that required to perform the task immediately. Second, some stages might be skipped, depending on the circumstances. The need for a task (stage 1), for example might already have been determined – hence the cost-benefit analysis (stage 2) might begin immediately.

### **5.2.2 Model of the Healthcare Context**

The Three Stage Model is similar to the traditional account – and to other accounts of interruption examined in the Literature Review Chapter – in its tendency to focus quite narrowly on the specific sequence of events that comprise these phenomena. However, by emphasising the micro aspects of interruptions, the more macro insights derived from Phase One, and from the literature review presented in (part one of) this chapter, are not adequately represented. These more macro insights related, in particular, to the role of the context of interruption, which might be important for several reasons: it underlies the aetiology of interruptions, it determines their nature, and it constrains how these events might be handled. By describing why and how the context matters, it is hoped that the model presented below will encourage interruptions researchers to pay more attention to this in future.

The model depicted in Figure 5-7 illustrates how interruptions can be understood at three different points along a ‘healthcare context continuum’. On the left side of the continuum, interruptions are described as a ‘basic switching event’ (an event where a clinician switches from a current task, before it is completed, to an additional task). The further one moves to the right, the more context is provided. The middle and far right positions, described in the text boxes, view interruptions in terms of a wider challenge of competing demands. (Demands are thought to compete with one another when they exceed the available resources.) While the middle position describes competing demands vis-à-vis individuals’ work, the right position pertains to competing demands at the healthcare system level.



*Figure 5-7 Healthcare context continuum (of interruptions and competing demands)*

### **5.2.2.1 Basic switching event**

When interruptions are viewed as a ‘basic switching event’, little or no information is provided regarding the healthcare context. For reasons that will become clearer in the sections below, the absence of context makes it challenging to make sense of interruptions, or to appreciate their wider role in healthcare.

The use of the term ‘basic switching event’ captures the simplicity of interruption, conceptually speaking (the concept is not a difficult one). It should not however



be taken to imply that *handling* interruptions is considered straightforward; the complexity of this endeavour is represented in the Three Stage Model described above.<sup>29</sup>

#### **5.2.2.2 Interruptions and competing individual demands**

At the mid-point along the continuum, interruptions are conceived – as they were vis-a-vis the basic switching event – as an individual phenomenon (that is, they relate to the switching of an individual clinician's attention). What is added at this point however, is the notion that interruptions are part of a bigger challenge: managing competing demands.<sup>30</sup>

The benefits of viewing interruptions in relation to competing demands were described in detail in Phase One. To reiterate the main arguments, the concept (competing demands) was thought to better illuminate the benefits of interruptions, better capture the complexities of these events (e.g. the fact that interruptions both add to, and support the handling of, nurses' workloads), and recognise much more clearly the context in which unplanned tasks have to be managed.

Phase One suggested that interruptions should be understood, primarily, as an adaptive strategy – or a resource for managing competing demands (situations where demands made of individuals exceed the resources available to them).

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<sup>29</sup> As per Phase One, interruption was defined as an event where a clinician switches their attention from a current task, before completing it, to an additional task.

<sup>30</sup> The exact position along the continuum occupied by the account (of interruption) presented the current section is open to debate. The main assertion made by the author is that the level of context provided falls somewhere between the two extreme positions that are described.

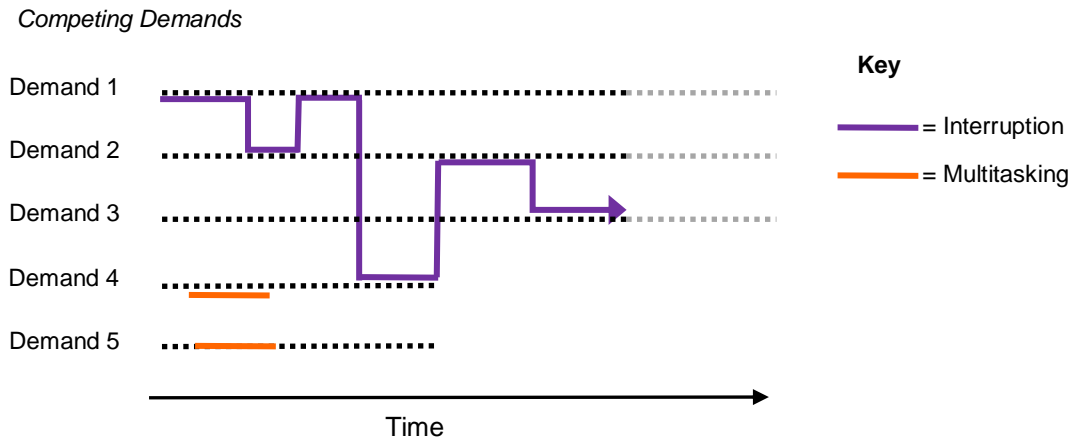
The current chapter has shown that multitasking is conceptually similar to interruptions, and it too can be considered an adaptive strategy. The two fundamental attention allocation strategies described by Wickens et al., (2012b; 1999) – Time Swapping (interruption) and Time Sharing (multitasking) – were thought to do a good job of describing the nature of, and the relationship between, interruptions and multitasking. (Full definitions of these and other key concepts described in the current section are described in Table 5-3.)

That Wickens et al's (2012b;1999) attention strategies were described in relation to time management was considered important since this distinguishes them from other adaptive strategies highlighted as potentially important in handling competing demands (e.g. strategies to support remembering; other strategies described in the macrocognition framework reviewed in section 5.1.3.2). Many of the adaptive strategies identified in Phase One, and in the current chapter, might have contributed to time management, but only interruptions and multitasking were *defined* by their supporting this.

Figure 5-8 depicts the relationship between interruptions, multitasking and competing demands, while definitions of each of these can be found in Table 5-3.<sup>31</sup>

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<sup>31</sup> Only the vertical (not the horizontal) purple lines on Figure 5-8 represent interruptions i.e. since it is only the act of switching that defines interruption (see Table 5-3).



*Figure 5-8 Interruptions and multitasking: time management strategies that support handling competing demands*

*Table 5-3 Key definitions for conceptual framework*

- **Interruption.** The act of switching attention from a current task, before completing it, to an additional task. (Also described in the current section as 'a basic switching event'.)
- **Multitasking.** Where individuals perform two or more tasks simultaneously, and divide resources strategically between them (e.g. they might devote 60% to task 1 and 40% to task 2).
- **Competing demands.** A mental or physical list of tasks for which an individual is responsible, and which he intends to complete during his work shift. Competing demands must be handled within the constraints of the complex and dynamic healthcare environment.
- **Unplanned task.** A task that a clinician is required to perform but which he was not aware of before the start of his work shift. Might include a task that was initially 'planned', but which had to be rearranged e.g. because circumstances meant the task was no longer viable. (The notion of being 'planned' implies that the clinician had organised some resources to support handling of the task.)

### ***5.2.2.3 Interruptions and competing system demands***

The notion that healthcare work can be understood in terms of the balance between demands and resources is extended at the far right of the continuum, to the level of the healthcare system. Healthcare systems can be understood as an attempt to organise resources in order to optimally manage healthcare demands. Figure 5-9 – which is spread over two pages – presents an integrated model incorporating all three positions on the Healthcare Context Continuum. On the first page, an adapted version of SEIPS (Carayon et al., 2006) is used to describe

the 'Interruptions and Competing System Demands' position. SEIPS has been reframed as a model of healthcare demands and resources, not unlike the famous job demands-resources models developed by stress theorists (Demerouti et al., 1999; Karasek, 1979). Hence a list of *dynamic healthcare demands* has been added (on the left side of Figure 5-9), and the 'Work System' and 'Work Processes' components of SEIPS have been redescribed in terms of *healthcare resources*. Regarding the Work System, one of the five aspects of SEIPS, 'Tasks', has been replaced by Time ('tasks' are now considered vis-à-vis work demands). This reflects the crucial role of time as a resource in handling competing demands. Under the 'People' aspect, individual skills and knowledge, together with psychological factors, have been added after these were demonstrated, by a range of studies, to be important regarding individuals' ability to manage multiple demands. (Other important aspects of the work system identified in Phase One as important vis-à-vis competing demands were already included in SEIPS e.g. teamworking is listed under 'Organisation'.)

Outcomes remain on the model but a new 'feedback loop' has been added, linking outcomes to processes i.e. to represent adaptation. This addition appears in a revised version of SEIPS, and it implies that healthcare workers monitor outcomes, and amend their behaviours, dynamically, to better align desired and current performance (Holden et al., 2013).<sup>32</sup> Related to this, a new subheading has been added under 'processes' to capture adaptive processes (the list underneath that heading was generated based on the Phase One findings, as well as examination of the Macro cognition Framework; Klein et al., 2003; Schraagen et al., 2008).

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<sup>32</sup> This is consistent with the Phase One data, where nurses were seen to monitor outcomes extensively. Key adaptive strategies identified in Phase One and/ or the current chapter were also added to the model.

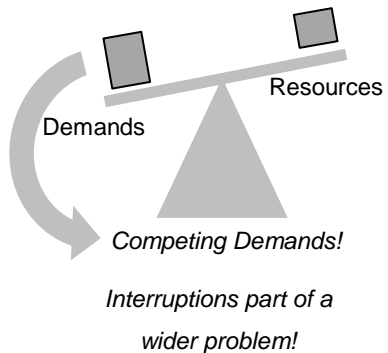
The reader will note that interruptions appear in three places on the diagram (see red text on first page of Figure 5-9). They are considered an adaptive strategy, an individual behaviour, and an additional demand on the healthcare system. This reflects the complexity of interruptions, in terms of their both adding to, and supporting the handling of, competing demands. Interruptions are 'exploded' over on to the second page of Figure 5-9, which depicts the other two positions on the Healthcare Context Continuum ('Interruptions and Competing *Individual* Demands' and the 'Basic Switching Event').

## DEMANDS & TASK FACTORS

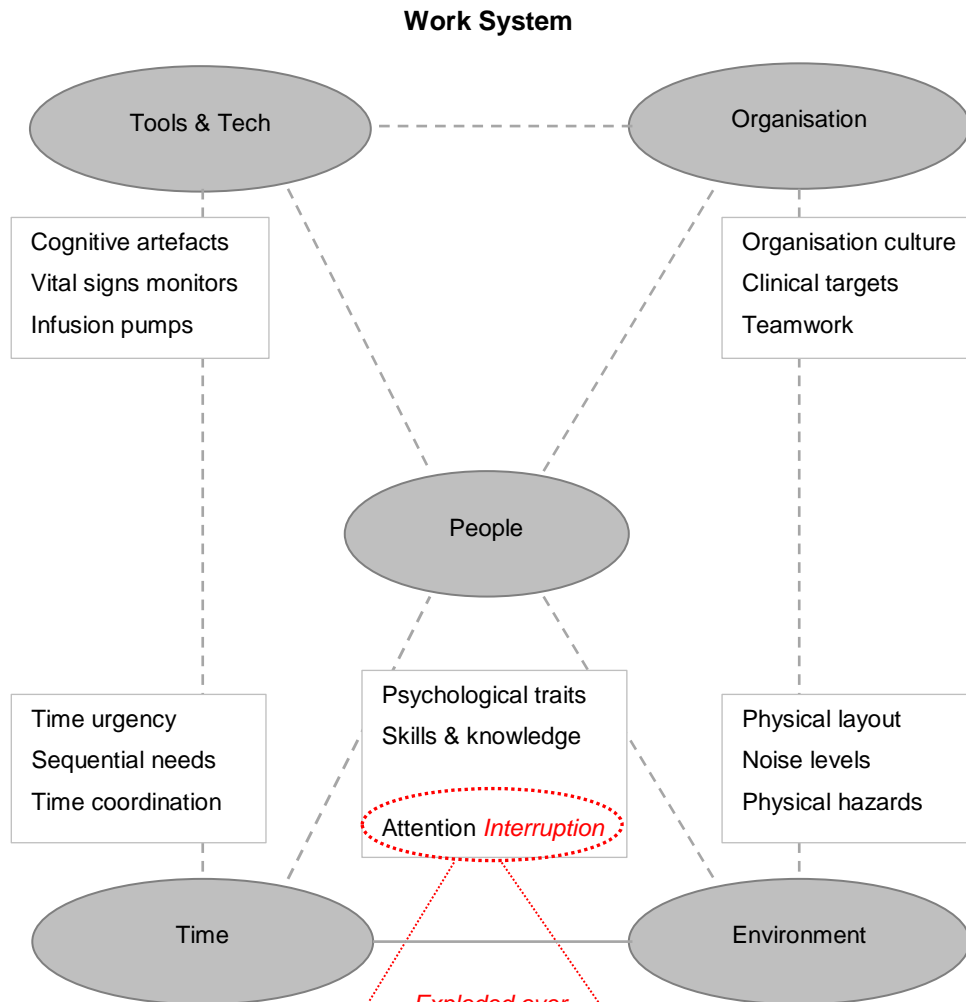
Changing priorities  
Unpredictable events  
Incomplete information  
Time constraints  
Task complexity  
Sequential requirements

Unplanned tasks

*Interruptions*



## RESOURCES



*Exploded over  
the page*

## Processes

### Care processes

Care pathways  
Treatment protocols  
Individual care plans

### Support processes

Cleaning  
Catering  
Maintenance

### Adaptive processes

*Interruptions*  
Multitasking

Time  
manage

Macroognitive  
strategies e.g. planning

*Strategic and  
opportunistic behaviours*

**Adapt**

## OUTCOMES

### Patient outcomes

Care quality  
Patient safety  
Satisfaction

### Staff & organisation

Job satisfaction  
Stress & wellbeing  
Health & safety  
Staff Turnover  
Organisation performance  
Profitability/ sustainability

Monitor performance

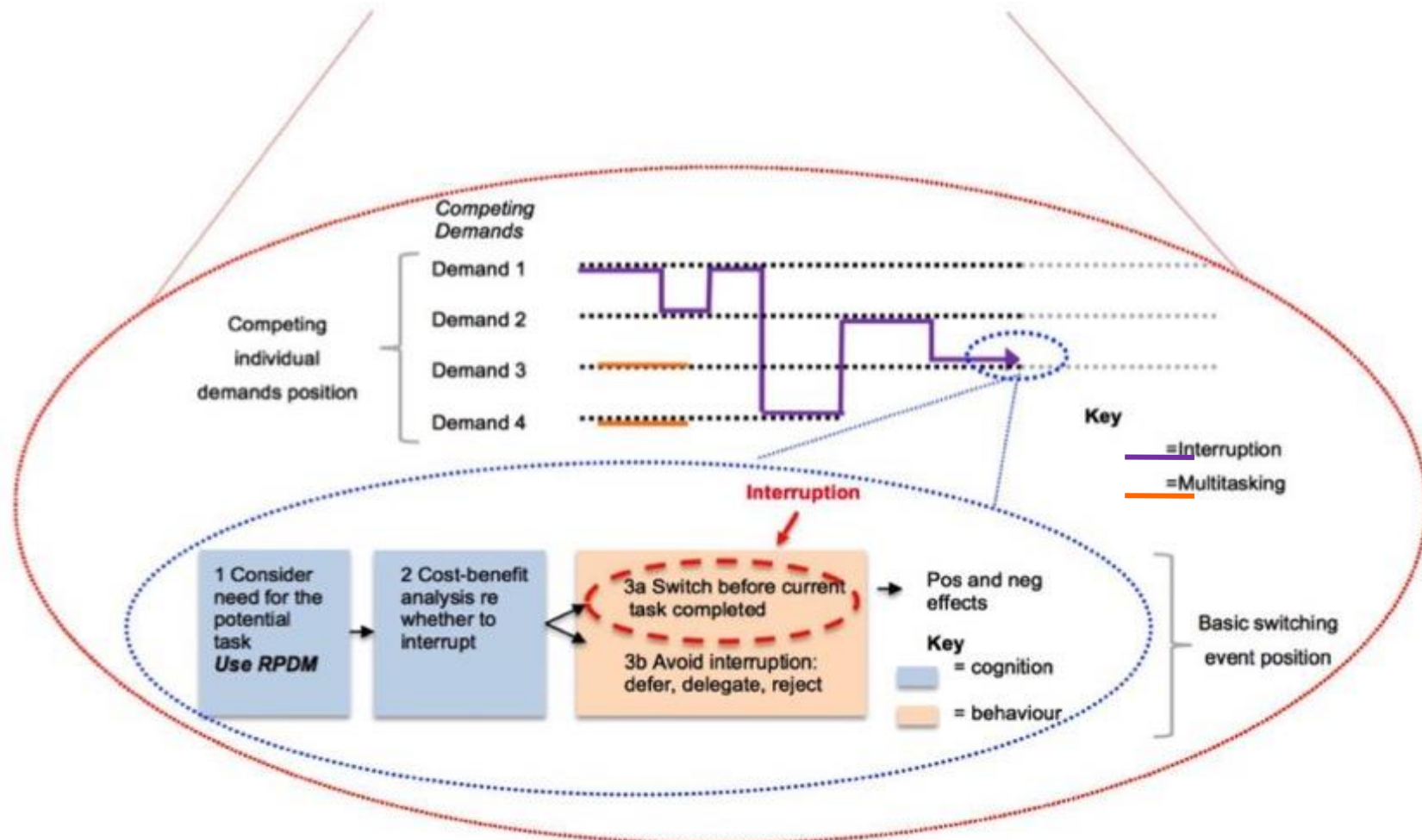


Figure 5-9 Integrated healthcare context model

## **Chapter 6 Phase Two**

Before describing the aims of Phase Two, it is helpful to recap briefly on what was learned in Phase One. Interactions among aspects of the clinical context – especially factors pertaining to work demands, and system resources – created complexity and dynamism, and resulted in competing demands – both for individual nurses, and for the healthcare system as a whole. Interruptions supported the handling of competing demands because they allowed nurses to respond quickly and flexibly, for example, however they also added to competing demands (e.g. since they usually created the need to resume a task). Key limitations of Phase One included a lack of precision in recording nurses' task management (i.e. since the researcher's understanding of specific nursing tasks was limited), a reliance on qualitative data, and the focus on interruptions (i.e. as opposed to competing demands more generally).

### **6.1.1 Aim of Phase Two**

Phase Two builds on the findings from Phase One, and addresses some of its limitations. The aim was to examine how nurses used adaptive strategies – including interruptions – as well as the wider healthcare system, to handle competing demands in the context of one discrete nursing task in each setting. The study was guided by the conceptual framework described in the previous (Concept Development) chapter, in terms of the phenomena that were examined and how the study was conducted. Specific objectives of Phase Two were to (for each setting):



- Provide a detailed description of one specific nursing task to support in-depth, contextualised analysis of nurses' handling of competing demands.
- Describe the nature and type of demands that competed for nurses' attention while they performed the specific task.
- Examine, systematically, how nurses used the work system, and key work processes, to support their handling of competing demands in the context of the specific task.
- Investigate adaptive strategies and behaviours used by nurses in handling competing demands during the specific task.

The specific nursing tasks examined were the ambulance triage in A&E, and the medications round in the surgical ward. These tasks were selected on the basis that they were seen (during Phase One) to be: 1) discrete tasks, that could be clearly delineated; 2) performed commonly by nurses with differing experience levels; 3) often required nurses to juggle competing demands; and 4) could be observed without disrupting care.

## **6.2 METHOD**

### **6.2.1 Participants**

Participants were nurses (8 per setting) working in two of the study settings, A&E and the surgical ward, included in Phase One. The third study setting, the chemotherapy centre, began a substantial restructuring after Phase One, and the ward management refused the researcher's request for access.

The rationale for sampling was similar to Phase One; nurses of differing experience levels were sought, to help illuminate the role of experience in handling competing demands. Because of this, participants from Phase One were invited to take part. All were given a detailed description of the Phase Two data collection, and they were reminded of their right to withdraw. However, all of the original group, in both settings, agreed to participate. (See section 4.2.1 for details of participants' background and experience levels).

## **6.2.2 Tools and Measures**

### ***6.2.2.1 Task Activity Data***

A smartphone application called iLogger, loaded on to an iPhone 4 (iOS 6), was used to record nurse's task management, in real time. iLogger is a flexible event-logging program that allows users to design their own log templates.<sup>33</sup> The template developed for the current study recorded features of specific task activities; each log pertained to a subtask vis-à-vis the specific nursing task being observed (e.g. in the context of the ambulance triage, a log might relate to entering patient details on to the computer). Logs were automatically time-stamped, while drop-down menus were created to record:

- Whether the activity being performed was part of the specific nursing task being observed, or whether it was an unplanned task
- Which subtask task was being performed (if it was a recognised triage subtask – as opposed to an unplanned task)

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<sup>33</sup> Permission to use the iLogger application was granted by the developer, Maddysoft Applications.

- Whether the task was interrupted, or whether it was resumed from earlier

Example screenshots from iLogger are shown in Figure 6-1. iLogger templates also included free-text boxes, allowing the researcher to capture detailed qualitative data regarding the immediate clinical context (e.g. aspects of the work system that might support or constrain the nurse, such as the availability of tools or colleagues) – as well details of any unplanned tasks that nurses managed alongside the specific nursing task.



Figure 6-1 iLogger application example screenshots

### 6.2.3 Procedure

The Phase Two data collection proceeded in three broad stages. The first stage involved the use of Hierarchical Task Analysis (HTA) to delineate the requirements of one discrete nursing task in each of the study settings; the second involved the piloting of specific tools and measures; and the third

comprised the substantive data collection i.e. including non participant observations, and post observation interviews.

#### ***6.2.3.1 Hierarchical Task Analysis (HTA)***

HTA is a method used to decompose tasks into discrete steps, in order to identify key actions involved in a particular work activity (Kirwan and Ainsworth, 1992; Stanton, 2006). Different individuals go about their work in different ways – even when performing similar tasks. Nevertheless, it is possible to identify a set of generic task steps performed by clinicians to complete tasks successfully. By providing a standardised ‘template’ of the selected nursing tasks, HTA allowed more detailed and precise recording of nurses’ handling of competing demands. (The task descriptions generated through HTA were used as the basis for recording nurses’ handling of tasks using the iLogger application). An additional benefit was that HTA provided a basis for distinguishing planned and unplanned tasks (since any tasks that nurses handled alongside the HTA task to which they had been allocated could be regarded as unplanned).

Other methods, in addition to the Phase One data, used to support the development of the HTAs included a review of relevant NHS Trust protocols, as well as short HTA interviews. The use of these specific data sources, as well as the use of multiple methods more generally, to support HTA, is consistent with recommendations made by prominent HTA researchers (Annett and Stanton, 2000; Stanton, 2006).

NHS Trust protocols were read thoroughly and notes were made regarding how key procedures might constrain nurses’ handling of tasks.

Two experienced nurses in each setting – individuals who had participated in Phase One – were asked to take part in a short interview to help the researcher to delineate the main stages, goals and subgoals of the selected tasks.

The approach to the HTA interviews followed that described by Stanton and colleagues (Annett and Stanton, 2000; Stanton, 2006). The researcher sketched out, in advance of the interview, a broad outline of the task, based on the above mentioned data sources. Task outlines were then used as a starting point to discuss the main stages and features of the task, and the nurse's goals at each point. Key decision points within the task were identified, and information requirements highlighted. Task decomposition continued until an adequate level of detail was obtained, given the study objectives. HTA interviews lasted around thirty minutes and were conducted in private rooms, on hospital premises. Detailed notes were made using pen and paper but the interviews were not audio recorded.

#### **6.2.3.2 Pilot Study**

The second stage of the Phase Two study involved the piloting of specific study methods, tools and measures. The researcher observed three nurses in each setting, over three 90-minute sessions (i.e. nine hours in total), and made notes regarding the usability of tools and devices, and the quality of the data elicited. Three key findings from the pilot study are described below, together with a summary of how the tools and measures were adapted to reflect these.

The first finding was that more qualitative data could be recorded (in addition to the quantitative task management data, described above), in real time, than had been anticipated – while such data was also considered rich and illuminating vis-a-vis competing demands. To maximise the benefits of the qualitative data, ‘free text’ boxes in the iLogger application were made larger, and the application interface was refined to enable easier data entry.

The second finding related to the high degree of detail included in the HTAs. Nursing tasks were decomposed into a large number of subtasks – yet this caused difficulties for recording events, in real time, using iLogger (since the time required to select the relevant subtask from a *long* list of subtasks made it difficult for the researcher to ‘keep up’ with events). The HTAs were simplified so that the number of subtasks was reduced to a more manageable number (i.e. from 25-35 subtasks to 15-20).

The third finding concerned the reliability of behaviour/ event coding. A number of examples were recorded where the researcher was uncertain about how an event/ behaviour should be coded. Most of these related to the incidence of unplanned tasks, and/ or specific strategies used to manage these. To ensure this did not undermine the reliability of coding, each of the examples was analysed and compared with codings for previous similar events/ behaviours, and notes were made to clarify areas of ambiguity. The pilot study finished only when the researcher became confident that any such ambiguities had been addressed satisfactorily (i.e. such that reliability was close to 100%).

Interviews were piloted with one nurse working within each of the settings. No interview schedule was used since the researcher intended to ask about recent

and specific events (i.e. events recorded by the researcher during observations), that could not have been anticipated in advance. The pilot interviews highlighted (as Phase One had done) the need to encourage nurses to focus on the specific events of interest, since nurses tended to talk in general terms about how they managed their work, when efforts were not made to reorient them back to the particular scenario.

#### ***6.2.3.3 Non Participant Shadowing Observations***

Eight nurses in each setting (sixteen in total) were shadowed as they performed the HTA tasks, for three 90-minute sessions each. Details of nurses' task switching and handling of competing demands – as well as notes regarding the constraints and the resources of the clinical context – were captured on the iLogger application. Potential constraints included time pressure, specific task demands, and patient characteristics; resources included various tools and devices, and teammates who could help with particular tasks, or alleviate demands from the nurses' general workload.

Nurses were observed at different times of day, with afternoon and evening periods sampled more than mornings, since the former tended to present more competing demands (as identified in Phase One). Referring specifically to the surgical medications round, three of the surgical nurse's four daily drugs rounds (starting at 08.00; 12.00; and 18.00) were seen. (The 14.00 round frequently involved the administering of only one or two medications, hence the other rounds were sampled).

Where the researcher was unclear about the nature of observed events or behaviours, he sought clarification from the nurse. Where possible, this was done in real time, as events were unfolding; where the nurse was engaged in direct care, questions were asked as soon as possible afterwards. Gaining insight into nurses' perceptions of events was considered especially important given the Phase One finding that interruptions were not always preceded by an obvious (and, therefore, easily observable) event – and because subjective, cognitive processes were found to be crucial.

The researcher used breaks between observation sessions to make fieldnotes summarising emerging themes regarding nurses' handling of competing demands – and factors that might have shaped this.

#### **6.2.3.4 *Post-Observation Interviews***

Interviews were conducted immediately after each shadowing session. They were conducted face to face, with a sub-sample of four nurses in each setting, and they explored issues relating to nurses' handling of a specific episode of competing demands (a period of time, lasting up to two hours, where nurses were required to handle many, or difficult, competing demands), recorded by the researcher during observations. The purposive sampling of nurses for interviews was informed by whether an interesting episode of competing demands had been observed, nurse experience, and individuals' perceived ability to reflect upon their task management behaviour.<sup>34</sup> A mix of junior and senior nurses were sought to illuminate the role of experience in nurses' task management.

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<sup>34</sup> Nurses' capacity to reflect was assessed subjectively by the researcher, on the basis of discussions held during observations.



Focusing on recent and specific episodes of competing demands had a number of benefits: 1) nurses' work was not disturbed, as it would have been using a method such as Think Aloud (Schooler and Engstler-Schooler, 1990; Ericsson and Simon, 1993); 2) nurses were less susceptible to memory distortion, or post-hoc rationalisation (Ericsson and Simon, 1993; Patrick and James, 2004); 3) observation data could be used to support nurses' remembering of key events; 4) the researcher was able to explore episodes thought most likely to illuminate the study goals (i.e. through purposive sampling of the nurses/ episodes).

Interviews lasted 45 minutes and were conducted in private rooms. The researcher drew on established cognitive interview techniques, including Directed Inquiry (Klein and Hoffman, 2008, p70) the Critical Decision Method (Klein et al., 1989; Crandall et al., 2006, chapter 5), and the Critical Incident Technique (Flanagan, 1954).

Having obtained consent, the researcher began the interview by asking the nurse to suggest an incident that occurred during observations, and which involved competing demands. Where several events were proposed, a brief discussion took place regarding which was most appropriate; but where no one incident stood out, two or three 'mini interviews' were conducted.

Nurses were asked to provide a broad overview of the incident, including tasks that were performed, tools or strategies that were used, the individuals involved – and to depict this information on a timeline, using pencil and paper. Where the nurse was concerned regarding her memory of events, observation data were

used to support this. An example timeline – henceforth described as a Basic Timeline – is presented in Figure 6-2.

After the Basic Timeline was completed, the researcher asked more detailed questions about specific aspects of the incident (e.g. the demands at different stages; the resources available; why the nurse used a particular strategy, etc), using the established chronology to provide a structure. There were no ‘set’ questions, and no interview schedule – but the researcher did keep a list of key findings from Phase One, as well potential themes emerging in the current study, to hand, to use as a prompt.

To illuminate issues that were difficult to ask about directly (e.g. because they involved behaviours that nurses were not conscious of), and to handle nurses’ tendency for post-hoc rationalisation, nurses were asked what they might have done had the situation been different in certain respects – or what might have happened had they used an alternative strategy. Nurses were also asked to describe the emotions they experienced when juggling conflicting demands, to illuminate the role of affect in nurses’ task management behaviour.<sup>35</sup>

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<sup>35</sup> See General Method section (in Research Design and General Method Chapter) for more details of interview procedures.

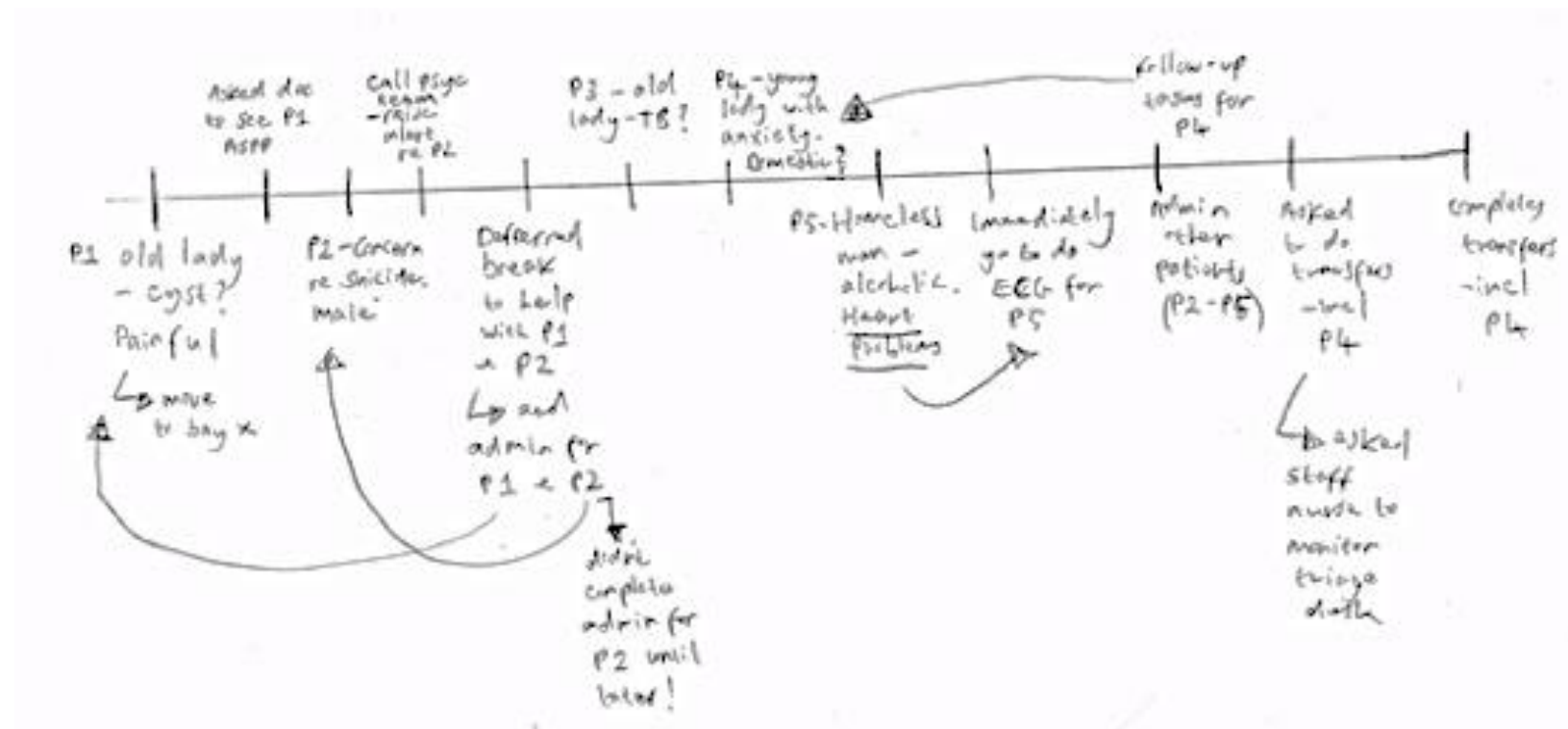


Figure 6-2 Example of a Basic Timeline produced by nurses during interviews

An extract from Post-Observation Interviews can be found in Appendix K.

Table 6-1 provides a summary of the Phase Two data collection. Note that 3 of the 24 observation sessions scheduled in each ward had to be cancelled due to problems arising on the day e.g. nurses being redeployed (i.e. and hence not performing the specific HTA task).

*Table 6-1 Data collection for Phase Two*

<b>Setting</b>	<b>Surgical Ward</b>	<b>Accident &amp; Emergency</b>	<b>Total</b>
HTA Interviews (hours)	2 (1)	2 (1)	4 (2)
Non participant observation sessions (hours)	21 (31)	21 (29)	42 (60)
Number of nurses observed	8	8	16
Post-observation interviews (hours)	4 (3)	4 (2.75)	8 (5.75)

## **6.2.4 Analysis**

A number of different analysis methods were used, including Hierarchical Task Analysis (HTA), descriptive statistical analysis, and bespoke analysis of nurses' task switching behaviour. A timeline analysis method was also developed to analyse data regarding specific episodes of competing demands.

### **6.2.4.1 Hierarchical Task Analysis (HTA)**

The HTA procedure described by Stanton and colleagues was followed (Annett and Stanton, 2000; Stanton, 2006). Nurses' feedback was used to revise the 'task outline' devised by the researcher (see Procedure section 6.2.3.1), and to develop a full hierarchical task diagram (e.g. see Figure 6-3 and Figure 6-4), with accompanying tables (e.g. Table 6-2 through Table 6-5). The diagrams and

tables adopt a standard HTA format (see the following for more information: Kirwan and Ainsworth, 1992; Stanton, 2006).

The hierarchical diagram depicts the nurse's goals, as well as the 'task plan' – a description of key task dependencies, relating, for example, to sequential task requirements, and the circumstances under which subtasks were necessary – or not necessary. The 'hierarchical' aspect concerns tasks being described at different 'levels' of analysis, with activities broken down in increasing detail as one moves from the top of the diagram to the bottom. Three such 'levels' were included in the HTAs conducted for the current study, described as the 'patient level', and 'subtasks level 1 and 2'. The patient level describes the overall goal of the task, in the context of an *individual patient's treatment*. In terms of the A&E ambulance triage task for example (Figure 6-3), the goal was to perform the triage *for each patient* quickly and accurately. Subtasks level 1 and 2 provide additional detail.

It should be noted that tasks were broken down only to the extent that this was useful (where usefulness was determined by the purpose of the HTA; to facilitate detailed, real time data collection using the iLogger application). The reader can see in Figure 6-3 that only three of the level 1 subtasks (numbers 2, 4 and 6) were further decomposed at subtask level 2 – the reason being that there was no need for the same level of detail for each subtask.

The HTA tables provide detailed prose descriptions of the tasks and subtasks represented on the diagram (Annett and Stanton, 2000; Stanton, 2006). The additional detail provided by these allows the reader to learn more about the

context of specific activities, and to better appreciate, for example, the information and skill requirements at different stages of the task.

As noted in the Procedure, the HTAs were simplified based on the findings of the pilot study. An example of the original, more detailed, HTAs is included in Appendix G.

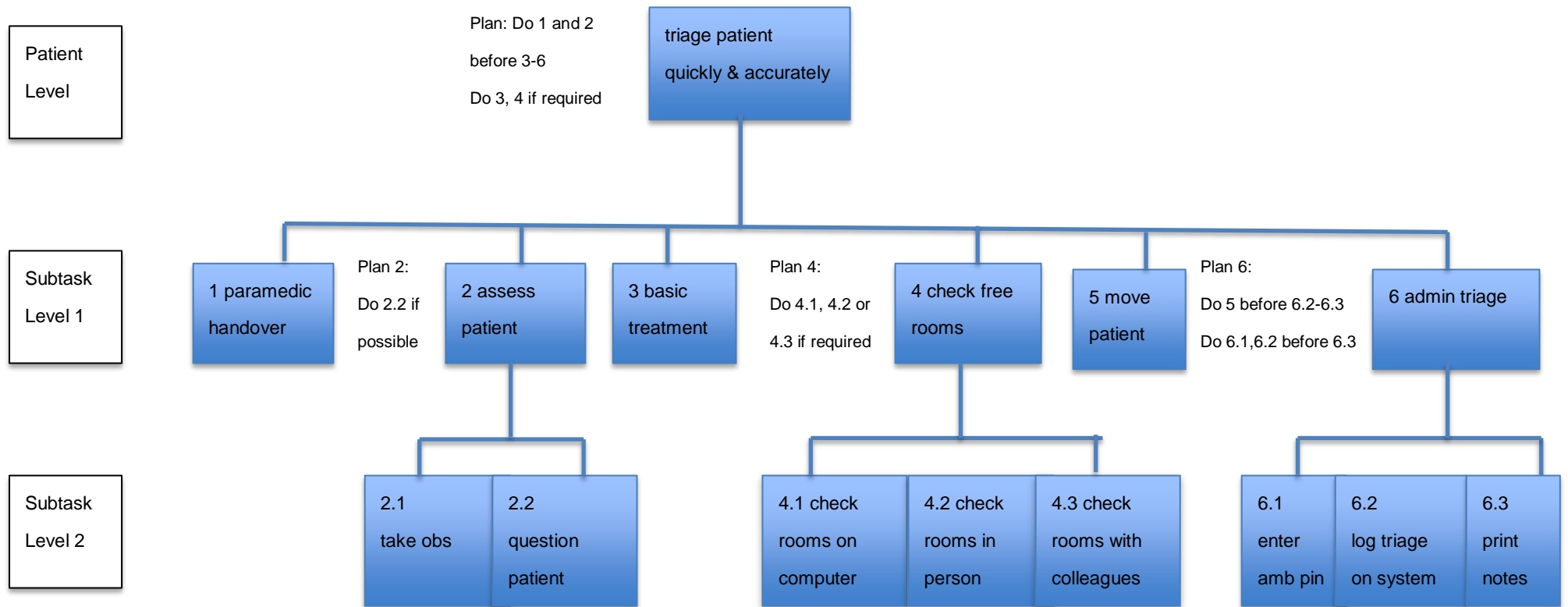


Figure 6-3 Hierarchical diagram: ambulance triage task (Accident & Emergency)

Table 6-2 Hierarchical table: A&E ambulance triage task – patient level

Task Analysis	Task described in further detail?	Notes
Triage patient quickly and accurately Plan: Do 1 and 2 before 3-6 Do 3,4 if required	Yes (see subtask level 1 and level 2)	<ul style="list-style-type: none"> <li>-Patients delivered by paramedic crews by [ambulance Service] as well as from a small number of private ambulances</li> <li>-Crews comprised of two paramedics – one drives the ambulance, and the other delivers direct care</li> <li>-The vast majority of ambulances have responded to 999 calls. Some patients however have been sent by their GP and are 'medically expected'. Such individuals are generally sent straight to the Medical Assessment Unit (MAU) without triage</li> <li>-Ambulance crews are directed to the nearest hospital – although patients who have traumatic injuries are taken to one of four major trauma centres in London (of which Hospital X is one).</li> <li>-The ambulance crew conduct their own assessment of the patient. They take vital signs recordings and seek details regarding the patient's medical history. They can also offer basic treatment (e.g. painkiller drugs etc)</li> <li>-All of the above information is documented on the Patient Report Form (PRF) which paramedics give to triage nurse</li> <li>-Nurses have 'visibility' of any ambulances that are heading for the hospital via the ambulance computer system</li> <li>-The triage nurse has a maximum of 15-minutes after the ambulance arrival to complete the handover (as per government targets)</li> </ul>

Table 6-3 Hierarchical table: A&E ambulance triage task – subtasks level 1 and 2

Task Analysis	Task described in further detail?	Notes
1 Paramedic Handover	No	
2 Assess patient Plan 2: Do 2.2 if possible	Yes (in rows immediately below)	While paramedics provide their assessment of the patient, nurses are required to conduct their own assessment
2.1 Take observations	No	For all patients, nurses record their blood pressure (using an inflatable cuff), pulse and oxygen saturation (using a finger-clip pulse-oximeter). Occasionally, nurses record the patient's temperature, blood sugar levels, etc.
2.2 Question patient	No	The nurse asks questions of the patient to aid their assessment. Common questions relate to any accidents, patients' symptoms, medical history, social circumstances etc. The nurse might also ask to see any injuries and/ or conduct basic mechanical tests (e.g. limb movement), or cognitive tests etc.
3 Basic treatment	No	The nurse offers basic treatments to patients with acute symptoms e.g. painkillers, anti-inflammatory drugs
4 Check free rooms Plan 4: Do 4.1, 4.2 or 4.3 if required	Yes (in rows immediately below)	On the basis of their assessment of the patient, the nurse decides whether the patient should be seen in the majors or minors department – and which bay the patient should be taken to.
4.1 Check rooms on computer	No	The nurse checks available rooms on the computer system.
4.2 Check rooms in person	No	The nurse checks available rooms in person i.e. physically.
4.3 Check rooms with colleagues	No	The nurse checks available rooms by asking colleagues



<b>Task Analysis</b>	<b>Task described in further detail?</b>	<b>Notes</b>
5 Move patient	No	After the nurse has completed the initial assessment, and decided where to put the patient, she must organise for the patient to be moved to a room. Nurses usually asked paramedics to move patients.
6 Administer triage Plan 6: Do 5 before 6.2-6.3 Do 6.1, 6.2 before 6.3	Yes (in rows immediately below)	
6.1 Enter ambulance PIN	No	The nurse must get the PIN number from paramedics and enter on the ambulance computer system.
6.2 Log triage on system	No	Once the patient has been 'booked on' (registered on the computer system – by reception staff) the triage nurse must add details of the triage to the system. Nurses often used the Patient Report Form (PRF) to support this task.
6.3 Print Patient Notes	No	The nurse must print the triage notes and place them in a file kept in the charge nurse area.

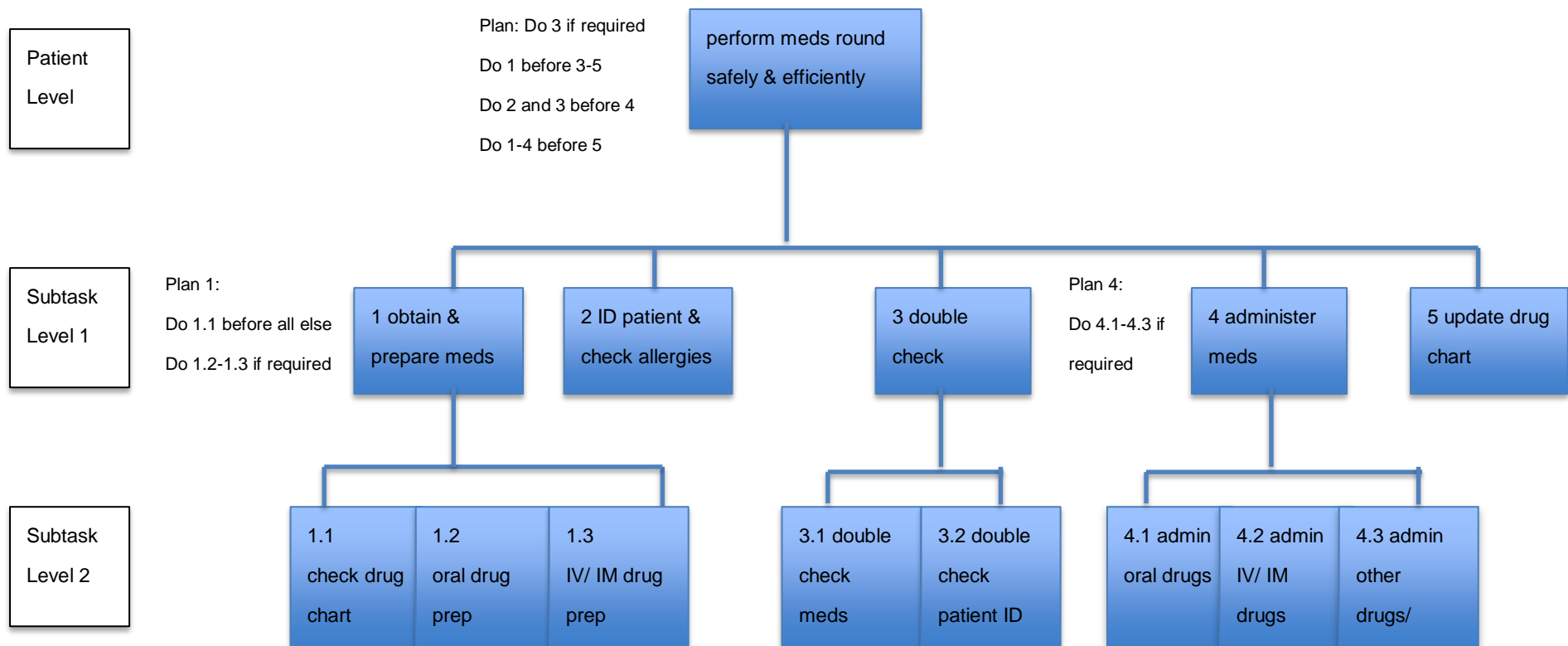


Figure 6-4 Hierarchical diagram: medications round (surgical ward)

*Table 6-4 Hierarchical table: surgical ward medication round – patient level*

Task Analysis	Task described in further detail?	Notes
Perform medication round safely and efficiently Plan: Do 3 if required Do 1 before 3-5 Do 2 and 3 before 4 Do 1-4 before 5	Yes (see subtask level 1 and level 2)	<ul style="list-style-type: none"> <li>-Medication rounds are performed by staff nurses at four times during the day (0800, 1200, 1800, 2200).</li> <li>-They were scheduled to last one hour,</li> <li>-Some drugs were given outside of the medication rounds e.g. because their dosage schedule differs from the timing of the rounds; or because the medicine was required urgently</li> <li>-Drugs charts are stored next to patient's beds and include details regarding: doses, routes of administration, timing etc. Charts include the following sections: regular prescriptions, variable dose drugs (e.g. hormones), and 'as-required' drugs (e.g. painkillers).</li> <li>-Pharmacists screen drugs charts to check prescriptions and to add information e.g. whether drugs should be taken with food</li> <li>-Drugs charts are marked to show whether drugs are 'stock' drugs (kept in stock on the ward) or whether they belong to the patient.</li> <li>-Patient's medicines are stored in locked cupboards next to their beds. All other drugs are stored in a cupboard in the medication room (although HDU maintains its own medication cupboard)</li> <li>-When patients are unable/ unwilling to take regular prescriptions, nurses use codes to indicate why (recorded on the drugs chart)</li> <li>-Nurses are not supposed to interrupt the drugs round at any point</li> <li>-Those receiving IV drugs will have a cannula or catheter fitted</li> <li>-Nurses can access drug protocols written and maintained by the NHS Trust on the intranet.</li> </ul>

*Table 6-5 Hierarchical table: surgical ward medication round – subtasks level 1 and 2*

Task Analysis	Task described in further detail?	Notes
1 Obtain and prepare patient medications	Yes (in rows immediately below)	<ul style="list-style-type: none"> <li>-Nurses working on the main ward usually prepare medicines in the medication room. HDU nurses usually prepare medications on their own bay. However, controlled drugs, such as opioids, are kept in a locked cupboard in the medications room. The nurse-in-charge generally keeps the key for this cupboard and nurses come to get it from her when required.</li> <li>-A variety of equipment is used by nurses to prepare medicines, including syringes, needles, and plastic trays. Nurses practice Aseptic Non-Touch Technique (ANTT) throughout drug preparation.</li> </ul>
1.1 Check drugs chart	No	Nurses start the round by checking patients' drugs chart (often for all patients).
1.2 Oral drug preparation	No	Oral medicines are obtained from the relevant cupboard and put in a small paper cup for the patient.
1.3 IV and IM drug preparation	No	<ul style="list-style-type: none"> <li>-Intravenous (IV) and Intramuscular (IM) medicines come in a variety of forms. Some drugs (often antibiotics) come in powdered form and must be reconstituted – while others must be mixed with dilutants (e.g. water, saline, or glucose)</li> <li>-IV drugs can be administered from a liquid pouch (for infusion) or in a syringe (for bolus injection). Other equipment required for IV administration (e.g. giving sets, infusion pumps etc) and IM administration (e.g. syringes) will also be</li> </ul>

Task Analysis	Task described in further detail?	Notes
		gathered at this stage. -IV drugs were, in many cases, prepared/ administered separately from the main drugs rounds e.g. night shift nurses often administered IVs before they finished their shift (at 8am)
2 Identify patient and check allergies	No	The nurse identifies the patient either by checking his/her armband or by asking them their name and date of birth. The nurse will also check whether the patient has any allergies – again either by checking the patient's armband or by simply asking them.
3 Double check	Yes (in rows immediately below)	A number of medicines are supposed to be double-checked by another qualified clinician before being administered. These include: controlled drugs, antibiotics, insulin, minerals etc. The witness is required to check the name, strength, and dose match that written on the prescription.
3.1 Double check medications	No	
3.2 Double check patient ID	No	
4 Administer medications	Yes (in rows immediately below)	After checking the drugs chart, nurses administer medicines
4.1 Administer oral drugs	No	Nurses try to observe patients taking oral medications – particularly if they are controlled drugs – to ensure that the patient's drugs chart accurately reflects what they have taken.
4.2 Administer IV/ IM drugs	No	IV drugs are administered as bolus injections or infusions. Bolus injections are administered over a short period (e.g. 3-5 minutes), and are often given 'manually' (i.e. they use a watch to establish the appropriate speed of injection). However, some injections can take 20-30 minutes and require the use of a 'syringe driver' (a machine programmed to inject drugs at the right speed).
4.3 Administer other drugs/ treatments	No	
5 Update drugs chart	No	

#### ***6.2.4.2 Descriptive Statistics***

The quantitative data (i.e. from iLogger) were imported into Excel 2011, and checked for anomalies and outliers. Frequency charts and measures of central tendency (e.g. the mean and the median) were used to understand how key variables were distributed, and to describe basic patterns in the data.

#### ***6.2.4.3 Task Switching and Multitasking***

The analysis of nurses' task switching and multitasking behaviour also made use of descriptive statistics, in some cases, however the interpretation of these was supported by insights obtained from the qualitative observation data. This accords with what Bryman (2006, p106) described as an 'explanation' strategy for integrating mixed methods data (i.e. where one method is used to help explain findings obtained from another; Bryman, 2006).

Techniques developed by Zheng and colleagues (2010; 2011) were adapted to facilitate the analysis regarding task switching frequencies (Table 6-11 and Table 6-15). These techniques pertain to the analysis and representation of patterns in organisational workflow.

#### **6.2.4.4 Timeline Analysis of Specific Episodes of Competing Demands**

Analysis regarding the specific episodes was conducted in two stages.<sup>36</sup> The first involved the development of a detailed description of events based on qualitative and quantitative data, from both observations and interviews; the second entailed using this description to support in-depth analysis of nurses' handling of competing demands.

##### **Stage 1: Detailed chronological description of events**

The detailed description was comprised of two main components: a Hierarchical Task Timeline (HTT) – a chronological diagram used to depict nurses' handling of competing demands in the context of the HTA task – and a prose description of events designed to accompany the timeline. The latter description provided a more comprehensive and contextualised account of key happenings, and it followed the same chronological structure as the HTT. This made it easy to obtain greater detail on any events of interest i.e. because events depicted on the HTT could easily be 'matched up' with a detailed written account of events. To be clear, the purpose of the HTT and prose description was to facilitate in-depth analysis of nurses' task management (at stage two of the analysis).

An example HTT pertaining to a two-hour episode observed during the surgical ward drugs round is presented in Figure 6-5. (An example prose description, relating to this episode, can be found in Appendix I.) The three coloured (or greyed-out) rows correspond to the three levels of the HTA diagram in Figure 6-4

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<sup>36</sup> Recall that Specific Episodes lasted up to two hours, and involved nurses handling many, or difficult, competing demands, in the context of the specific nursing task.

(page 249). The top row refers to the patient level – hence the numbers represent different patients. The middle and bottom rows relate to subtask levels 1 and 2 respectively, and the (non red) colours represent different HTA subtasks. Further explanation of the HTT is provided in the relevant part of the results section.

The HTT and prose description were developed especially for the current study – although they are similar in some respects to other timeline analysis methods (e.g. see Kirwan and Ainsworth, 1992, p136). The following steps were taken to produce the HTT: an initial draft was produced using quantitative observation data obtained from the iLogger application e.g. relating to the type of task performed, the timing of the task etc. This was checked against the Basic Timeline, developed by nurses during interviews, to ensure completeness, and to corroborate descriptions of key activities.

Rich qualitative data from interviews and observations relating to the constraints and resources of the clinical context, and nurses' handling of events, were then added to the draft HTT – as well as to the detailed prose description – using pen and paper. The types of issues covered included various task factors (e.g. task urgency, sequential requirements); how the nurse directed her attention and accessed information; the tools and equipment that she used; the colleagues she requested help from – or who proactively helped her; features of the physical environment that might have affected behaviour; and particular work processes (e.g. clinical protocols) that shaped action. Individual nurse factors relating to experience, personality, and organisational issues such as clinical targets, that were considered relevant (i.e. because they might have influenced nurses' behaviour) were also added to the HTT and prose description.

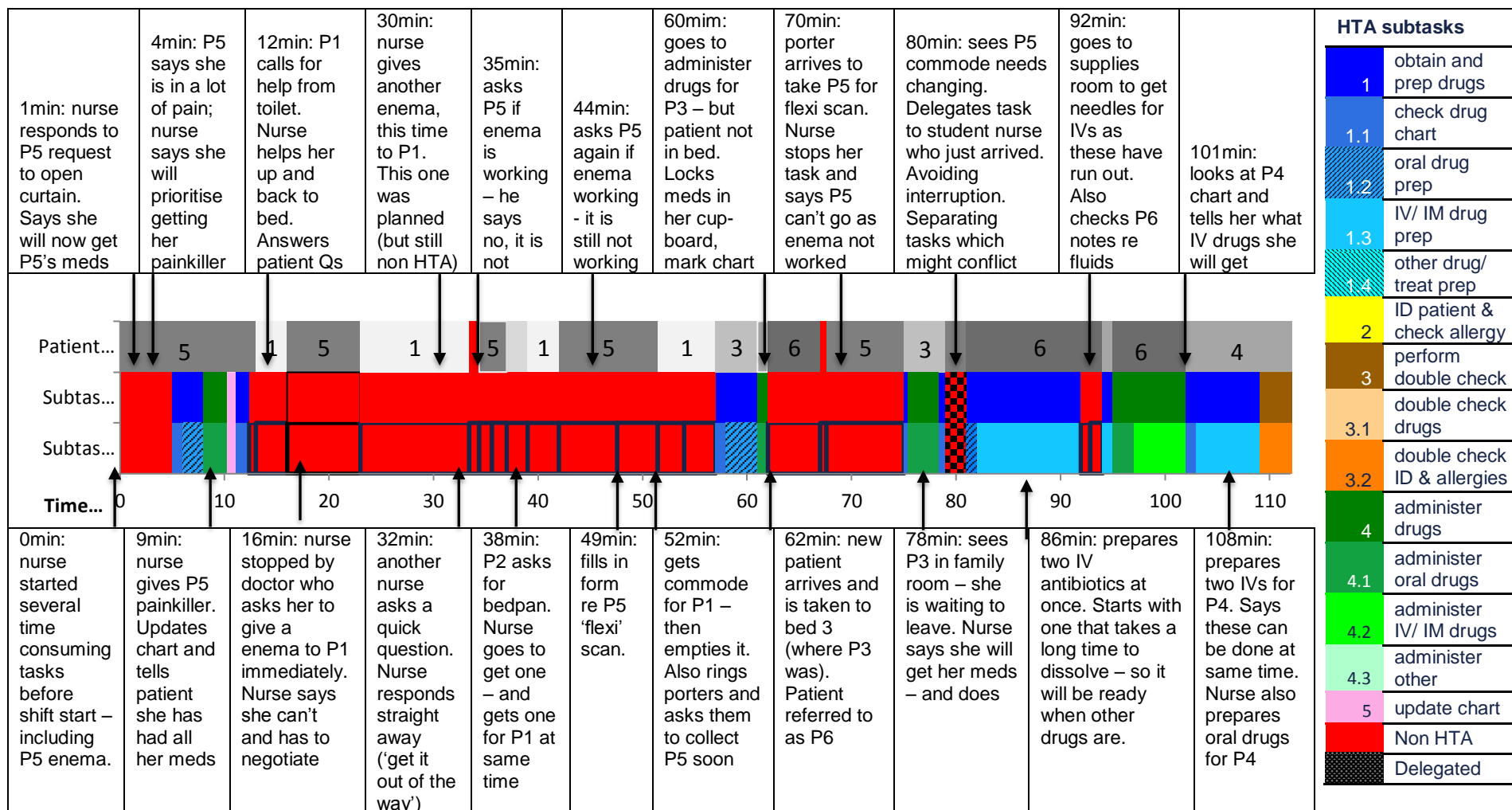


Figure 6-5 Example hierarchical task timeline (for illustration purposes only)



## **Stage 2: In depth analysis of handling competing demands**

The more detailed analysis drew on a number of cognitive analysis techniques, including Critical Decision Method analysis approaches (Klein et al., 1989; Wong, 2003; Crandall et al., 2006, chapters 5), and cognitive data representation techniques (Crandall et al., 2006, chapter 7; Klein and Hoffman, 2008).

The researcher used the HTT and prose description to immerse himself in the context of the episode, with the goal of understanding the demands that nurses faced at any given moment – and factors that shaped nurses' handling of these demands. He worked through events in accordance with the chronological order, and made analytical notes (on both the draft HTT and in the prose description) regarding the likely drivers of the nurse's behaviour, at every stage. The analysis was inductive, although the researcher had been 'sensitised' to specific aspects of the work system that might affect individual's behaviour, as well as particular adaptive strategies that individuals might use, based on the Phase One results and the Concept Development review.

The final steps involved organising the data into a thematic framework, using Framework Analysis Method (FAM; Ritchie, 2003), and comparing and contrasting key themes identified for each of the separate wards, using Stake's (2006) method. Further information regarding these methods can be found in the General Method Chapter (section 3.2.7). An extract of the framework created for the timeline analysis is included in Appendix J.

*Table 6-6 Overview of Phase Two analysis methods*

<b>Analysis Technique</b>	<b>Brief Description</b>	<b>Data Utilised</b>	<b>Strategy for Integrating Data</b>
Hierarchical Task Analysis (HTA)	Describes nursing tasks in terms of component parts, as well as key dependencies (e.g. urgency, sequential requirements)	*Notes from review of NHS Trust protocols *HTA interviews *Phase one observation data	*Phase one observation data, and review of protocols, used to sketch an initial outline of the task. Interview data used to extend and refine this, to make full hierarchical task diagram/ table
Descriptive Statistics	Describes basic aspects of nurses' work (e.g. tasks performed, duration) using frequency charts, measures of central tendency	*Quantitative observation data recorded using the iLogger application	N/A (only one type of data used)
Task Switching/ Multitasking Analysis	Examines how nurses switched among different tasks, tendency to interrupt, and propensity to multitask. Also includes more general analysis of nurses' adapting to competing demands	*Quantitative observation data recorded using iLogger *Qualitative observation data recorded using iLogger, or fieldnotes	*Analysis relied primarily on quantitative data. Qualitative data used to support interpretation of quantitative data
Analysis of specific episodes of competing demands	Develops a detailed description of events occurring during the episode – then uses this to understand factors that shaped nurses' handling of competing demands	*Qualitative data from post-observation interviews regarding specific episodes *Quantitative observation data recorded using iLogger	*Quantitative data (e.g. regarding task types, durations) from iLogger used to provide a basic description of events. *Qualitative data used to add substantial detail regarding context factors that affected nurses' behaviour

## 6.3 RESULTS

This section is structured in accordance with the main analysis techniques (although the 'results' of the HTA were already presented in the analysis section above) – hence the results are presented in the following order: 1) descriptive statistics regarding task durations, task types, and workload; 2) examination of nurses' task switching and multitasking behaviour; 3) timeline analysis of the specific episodes of competing demands that were observed by the researcher. Within each section the results are presented for Accident and Emergency, followed by the surgical ward, and ending with a comparison between the settings. Some of the sections include references to raw data, and they employ the format described in Table 6-7.

*Table 6-7 Format of references to raw data*

DC1INT 1,8 = chemotherapy centre, participant 1, interview transcript page 1, line 8
SU3SHA 3,21 = surgical ward, participant 3, shadowing observation notes page 3, line 21
AE3FN 1 = accident & emergency, participant 3, observation fieldnotes page 1

## **6.3.1 Descriptive Statistics**

### ***6.3.1.1 Accident & Emergency Ambulance Triage***

This section describes the main features of the data collection, as well as the main demands faced by nurses during the triage task (e.g. the types of tasks required, the duration of these tasks). This provides a context for the subsequent analysis of nurses' task switching and handling of competing demands (in sections 6.3.2 and 6.3.3).

On average, each nurse was observed for just over 3.5 hours (s.d. 0.92 hours). Figure 6-6 shows how observations were distributed across different times of the day. Afternoon and evening periods were over-sampled relative to mornings.

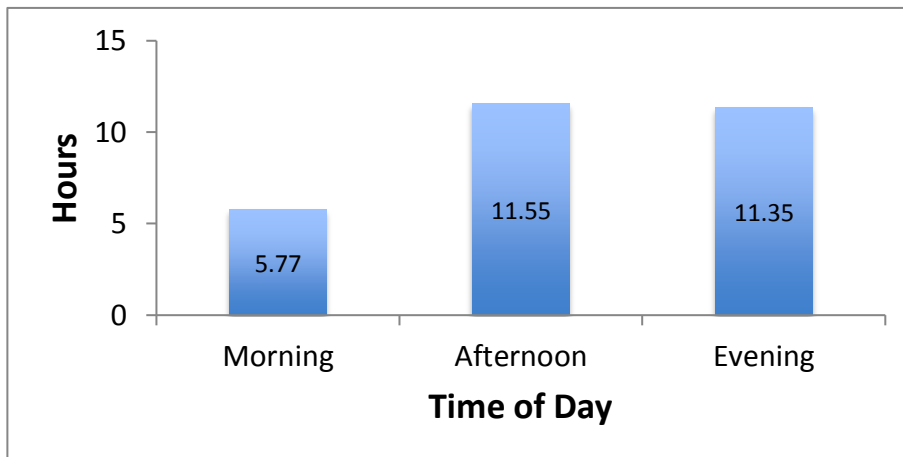


Figure 6-6 Observation duration by time of day<sup>37</sup>

Figure 6-7 shows the number of patients triaged during the observation sessions. The chart shows considerable variability between sessions – with some sessions involving no triages (nurse 3, session 1), and others seeing as many as eight (day 1, session 1; day 6, session 1). (Recall that session durations varied).

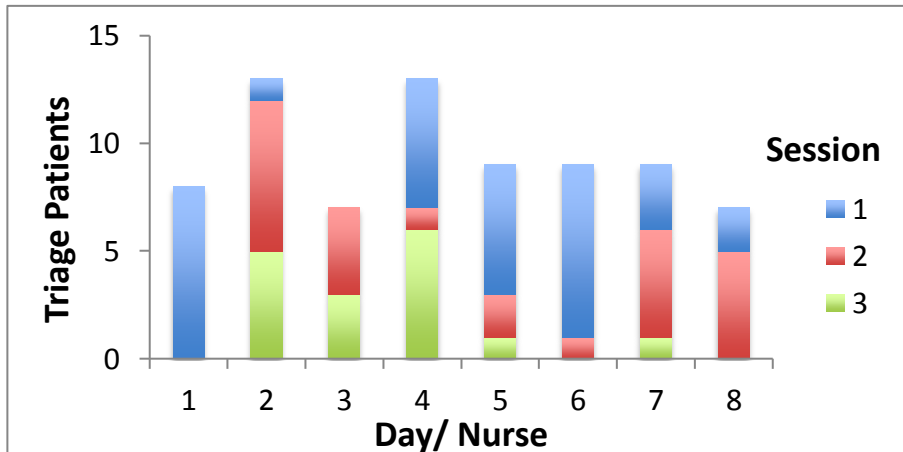


Figure 6-7 Patient volume by nurse

Figure 6-8 shows the distribution of task duration, for the HTA triage task, and for any unplanned tasks. (Unplanned tasks are henceforth referred to as ‘non HTA’ tasks, reflecting the fact that these were not part of nurses’ normal routine.) The

<sup>37</sup> Observation sessions were categorised according to the session start time. ‘Morning’ sessions commenced between 0900 and 1159; ‘Afternoon’ sessions between 1200 and 1659; and ‘Evening’ between 1700 and 2359.

majority of tasks were performed in less than two minutes, although a substantial minority of non HTA tasks took more than five minutes.

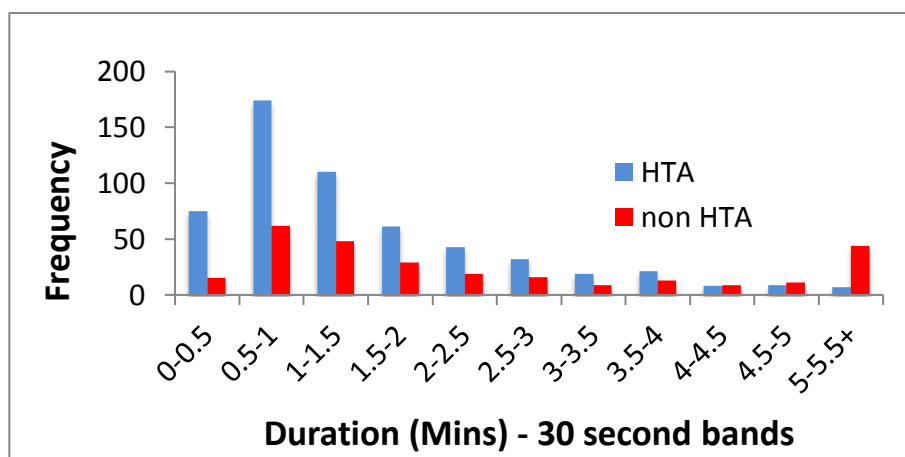


Figure 6-8 Task duration distribution

Figure 6-9 shows how much time (as a proportion) nurses spent performing the HTA triage and non HTA tasks respectively. Nurses' time was quite evenly spread across HTA triage tasks and non HTA tasks, with relatively little variation between days.

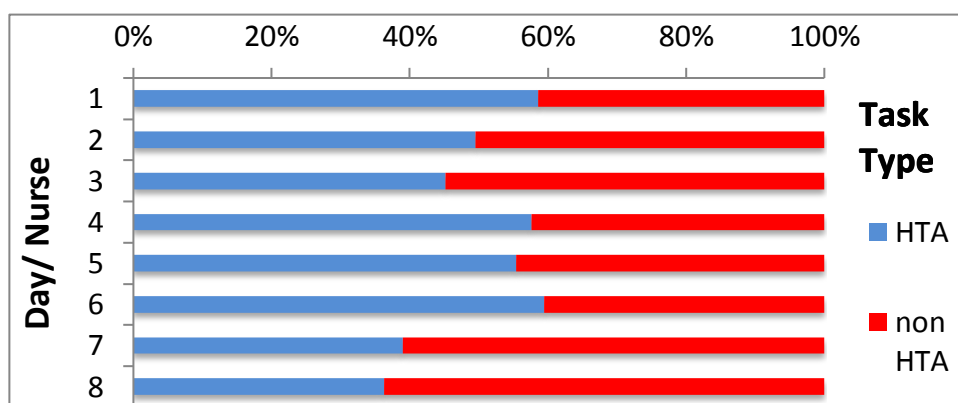


Figure 6-9 Duration by task type

Figure 6-10 depicts the average duration of the triage task. It suggests that nurses spent broadly similar amounts of time performing the triage task.

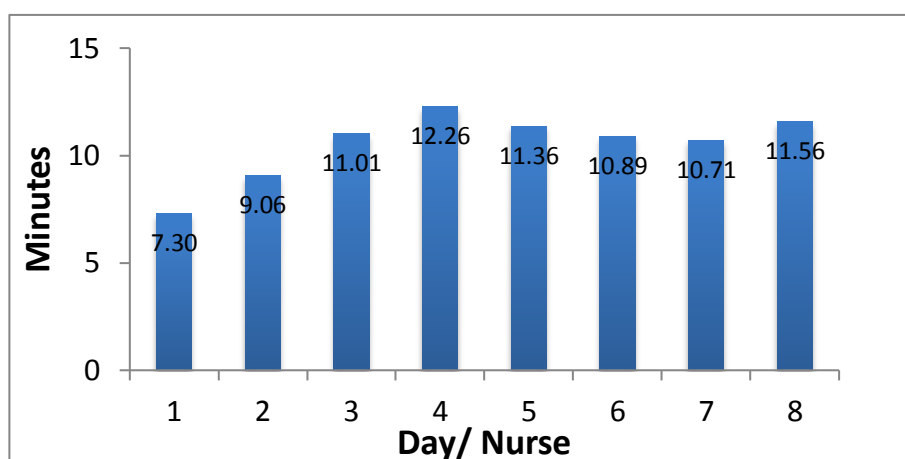


Figure 6-10 Mean triage duration<sup>38</sup>

### 6.3.1.2 Surgical Ward Drugs Round

On average, each nurse was observed for 3 hours and 6 minutes i.e. across the two or three rounds observed (s.d. 1.2 hours). Patient drug rounds, and hence observation sessions, lasted 1 hour and 23 minutes on average (s.d. 33 minutes). More morning rounds (8) were observed than afternoon (7) or evening (6) ones – although Figure 6-11 shows that overall, longer was spent observing afternoon rounds compared with the others.

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<sup>38</sup> Any unplanned tasks that were managed concurrently with the triage during the triage were excluded from this analysis to ensure that figures were comparable across days/ sessions.

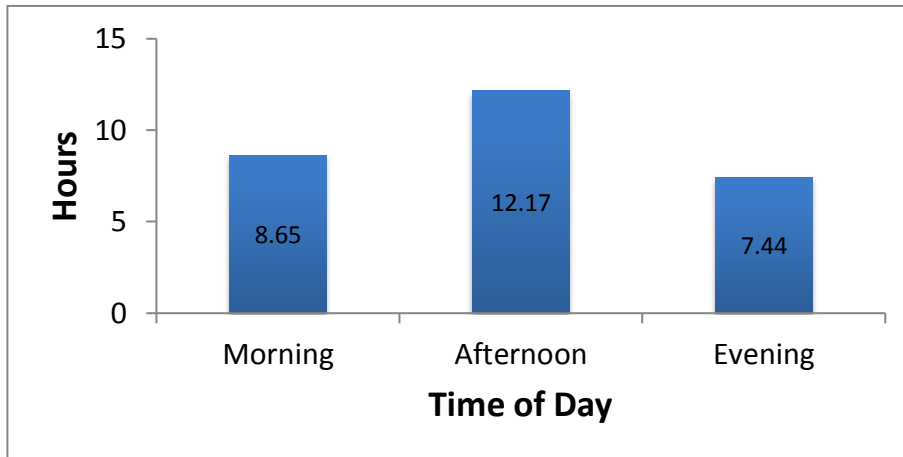


Figure 6-11 Observation duration by time of day

Figure 6-12 shows the number of patient rounds performed during each observation session. A fair degree of consistency was observed in the number of patients treated per session, while the mean was 4.48 (s.d. 0.98). That the nurse had fewer rounds in the sessions on days 7 and 8 reflects his/ her working in HDU on those days.

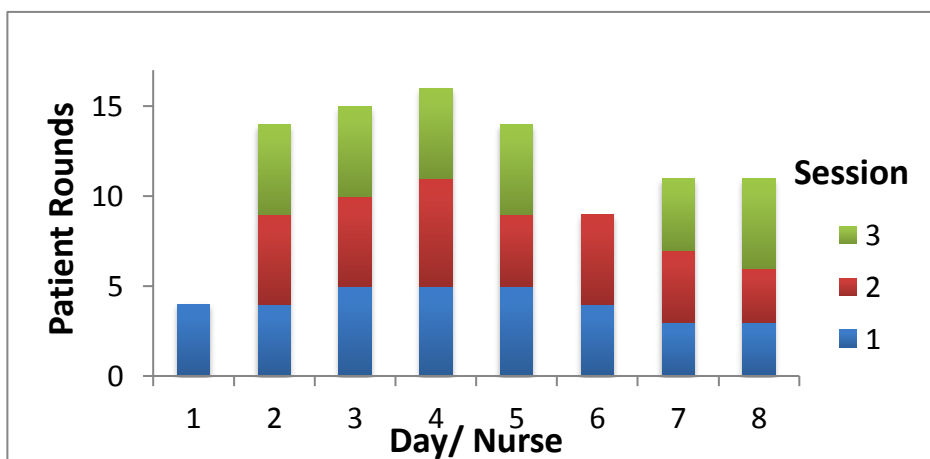


Figure 6-12 Patient volume by nurse

Figure 6-13 shows the distribution of task duration for the HTA drugs round task, and for non HTA tasks. The majority of tasks were performed in less than two minutes, although a substantial minority of tasks took longer than this.

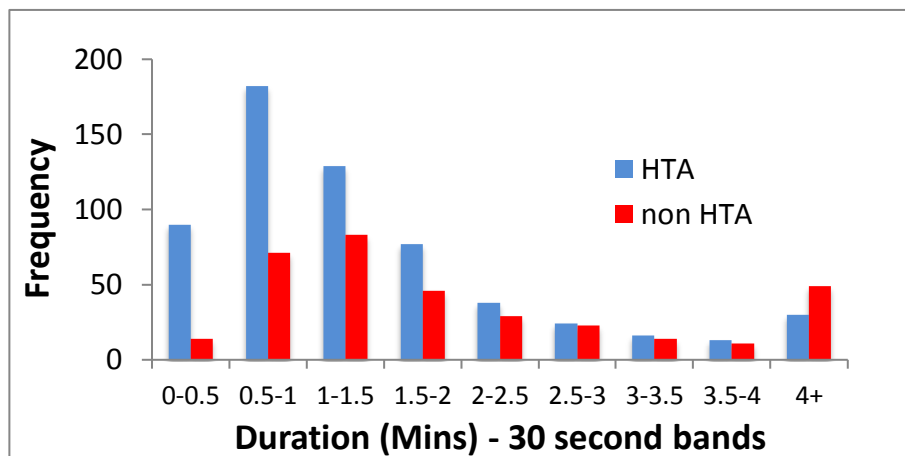


Figure 6-13 Task duration distribution

Figure 6-14 shows how much time (as a proportion) nurses spent performing the HTA drugs round task, and non HTA tasks. There was some variation, but most nurses spent between 2/5 and 3/5 of their time performing drugs round jobs.

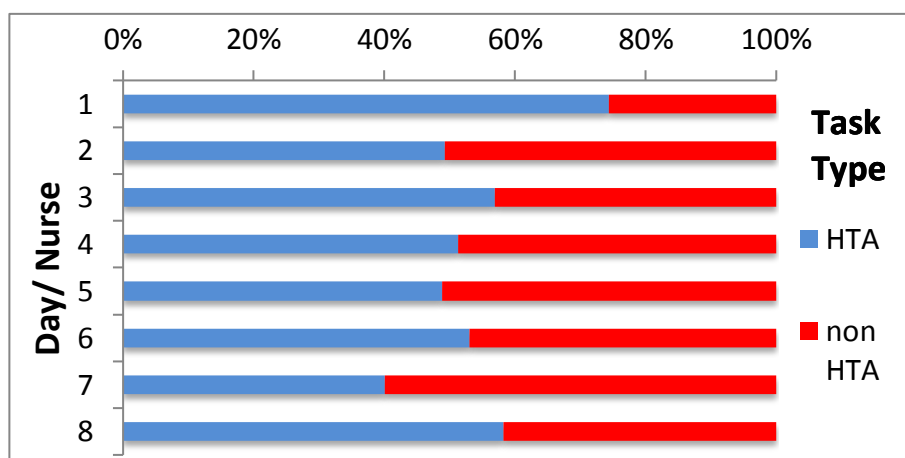
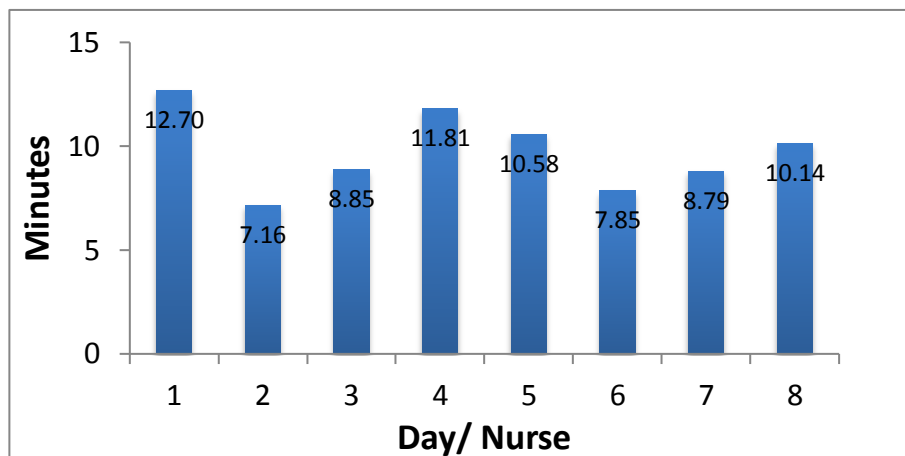


Figure 6-14 Duration by task type

Figure 6-15 depicts the average duration of HTA patient-rounds.<sup>39</sup> A surprising degree of variation can be seen across days, although this is reduced if the data for nurse 1 – which was comprised of a single session – are excluded.

<sup>39</sup> Any unplanned tasks that were managed concurrently with the triage during the triage were excluded from this analysis to ensure that figures were comparable across days/ sessions.





*Figure 6-15 Mean duration of patient rounds*

### **6.3.1.3 Summary and Comparison**

A summary of the main findings of the descriptive statistical analysis, together with a comparison between the study settings, is provided in Table 6-8.

*Table 6-8 Main findings of descriptive statistics*

- Patient volume was quite consistent in the surgical ward but there was more variability in A&E
- Around half of nurses' time in both settings was spent on non HTA tasks. Slightly more time was spent on non HTA tasks in A&E.
- The majority of tasks in both settings took less than two minutes.
- HTA tasks took longer on average than non HTA tasks, in both settings.
- The A&E triage task took slightly longer on average than the surgical medications round.

### **6.3.2 Task Switching and Multitasking**

A series of analyses of nurses' task switching and multitasking behaviour were conducted, to illuminate how nurses juggled competing demands. For the purpose of the current section, the term 'task switch' was distinguished from interruption. A 'task switch' was used to describe any type of task transition,

while interruption referred only to events where nurses switched from a current task, to an additional one, *before the current task was finished*.

### **6.3.2.1 Accident & Emergency Ambulance Triage**

To provide context, it helps to examine how often the HTA triage subtasks were performed, and how much time nurses spent performing them. (The triage HTA task is described in Figure 6-3, page 246). Figure 6-16 depicts mean subtask frequencies (per hour), while Figure 6-17 presents their mean durations.<sup>40</sup> The subtasks depicted in the charts represent the most detailed possible view of the HTA task. Those subtasks denoted by an integer on the x-axis label (e.g. subtask 3, basic treatment) were broken down at subtask level 1 in the HTA, while those denoted by a decimal number (e.g. subtask 2.1 taking observations) were described at subtask level 2.

Together, the charts suggest that the ‘core’ triage subtasks included the paramedic handover (subtask 1), patient assessment subtasks (2), moving the patient (5), and triage administration subtasks (6).

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<sup>40</sup> The subtask durations depicted in Figure 6-17 capture the total amount of time spent by the nurse on the subtask, for an ‘average patient’. Where the nurse stopped and started the task multiple times (for the same patient) the figures represent the sum of the nurse’s time spent working on the subtask.

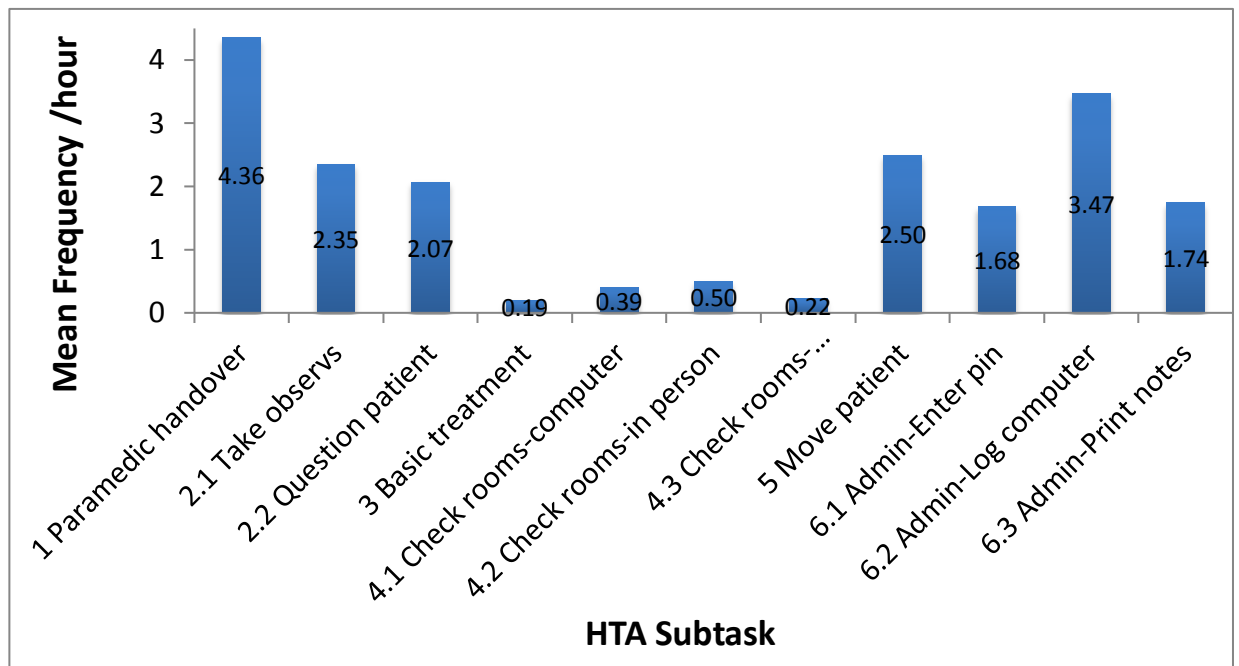


Figure 6-16 Mean HTA subtask frequencies per hour

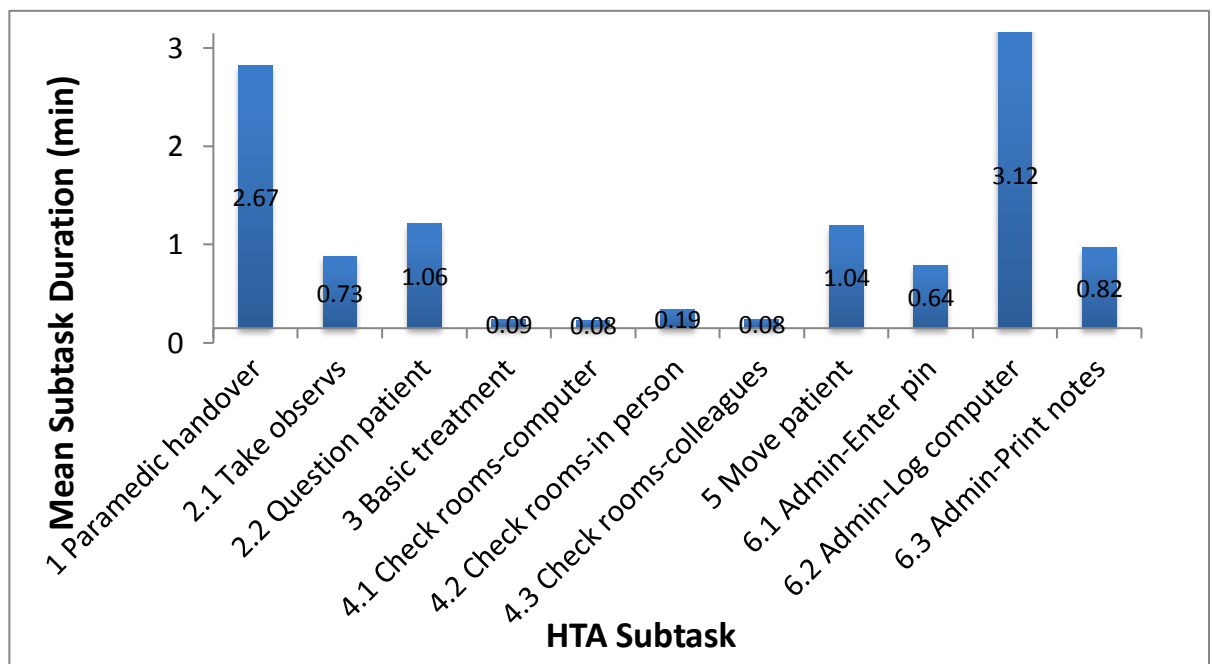
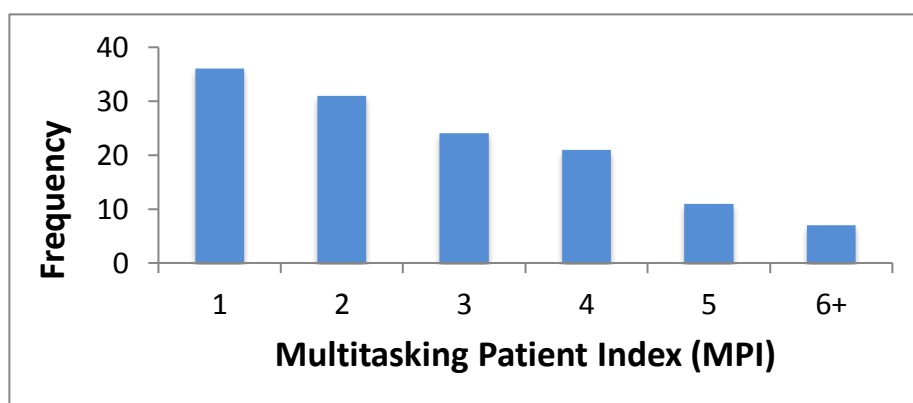


Figure 6-17 Mean duration of HTA subtasks (mins)

A new measure called the Multitasking Patient Index (MPI) was computed to quantify how many patient triages, on average, nurses managed at any one time. To be precise, the MPI reflects the mean of the ‘cumulative net number of

trriages' (the number of triages started minus the number completed), based on a snapshot of nurses' work taken at 15 minute intervals.<sup>41</sup>

A frequency distribution of the MPI is depicted in Figure 6-18. It shows that nurses spent the vast majority (more than 70%) of their time juggling multiple patients.

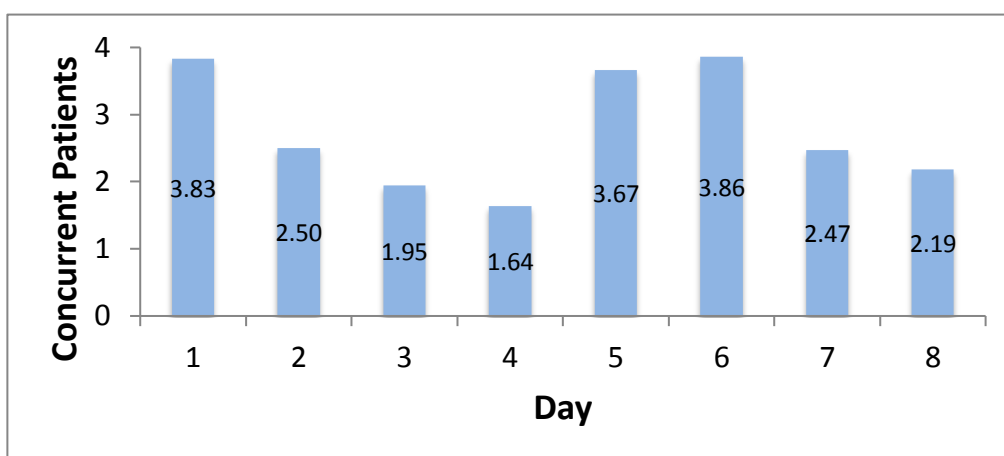


*Figure 6-18 Distribution of Multitasking Patient Index (MPI)*

Figure 6-19 depicts the mean MPI score for each day. The chart suggests some variability between nurses in the degree to which they 'multitasked' – although all nurses juggled patients to a fair degree.

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<sup>41</sup> The following two steps were taken to derive the cumulative net number of triages for each 15 minute interval: 1) the net number of triages per quarter-hour was calculated; 2) a running total of this figure was computed across the course of each day (i.e. the net number of triages from each 15 minute period was carried over to the subsequent period, within the same day), reflecting the number of patients the nurse was responsible for at any given time.



*Figure 6-19 Mean concurrent patients by day*

The MPI should be interpreted with caution due to the difficulty of standardising data collection in the chaotic clinical environment. The reader will note for example that the duration of observations varied by session, meaning that nurses had more chance of ‘accumulating’ patients in some periods than others. Another complication was that not all observation sessions commenced at the beginning of nurses’ shifts – hence nurses might have accumulated patients before data collection began. Finally, while the analysis assumes that observation sessions were contiguous (because it requires the researcher to observe the commencement and completion of new triages – to maintain the ‘running total’), practical constraints – including the lack of predictability in nurses’ schedules – meant a small amount of nurses’ work between sessions went unobserved.

Table 6-9 presents the mean number of HTA ‘task parts’ – the number of times each subtask was performed during the average triage – which provides a measure of work ‘fragmentation’. The results suggest that the paramedic handover (1) and triage logging (6.2) subtasks were the most fragmented – but even these tasks, it would seem, were often performed in just one part (i.e.

without interruption). These findings are consistent with qualitative fieldnotes, where it was noted that the paramedic handover was often interleaved with other tasks (AE3FN 1; AE5FN 1) – and where it was recognised that nurses often accepted requests for help from other clinicians when logging the triage (requiring them to stop and start the task multiple times; AE5FN 1; AE2FN 2).

*Table 6-9 Mean number of HTA task parts<sup>42</sup>*

HTA Subtask	Mean no. Task Parts (per triage)	S.D.
1 Paramedic handover	1.58	0.70
2.1 Take observations	1.31	0.55
2.2 Question patient	1.21	0.46
5 Move patient	1.08	0.70
6.1 Admin-Enter pin	1.07	0.55
6.2 Admin-Log computer	1.80	0.46
6.3 Admin-Print notes	1.06	0.70
Mean	1.30	0.55

Table 6-10 shows the proportion of HTA subtasks that were interrupted, and the number of interruptions *per primary task minute*. To provide an example of how to interpret the latter metric, the table indicates that the paramedic handover was interrupted 0.21 times per minute – or once for every five or so minutes that the subtask was conducted. The purpose of standardising the interruption rate in relation to the primary task duration was to account for the greater opportunity for interruption afforded by longer tasks (see Westbrook et al., 2010b).

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<sup>42</sup> The analysis describes the mean number of task parts *whenever the subtask was actually performed* – hence the minimum number was 1. Subtasks 3 and 4 were excluded from this analysis due to their very low frequency.

Table 6-10 Number and percent of HTA tasks interrupted<sup>43</sup>

HTA Subtask	Mean no. Interrupts (per primary task minute)	S.D.	Percent Interrupted
1 Paramedic handover	0.21	0.70	37%
2.1 Take observations	0.27	0.46	23%
2.2 Question patient	0.13	0.38	17%
5 Move patient	0.06	0.70	7%
6.1 Admin-Enter pin	0.06	0.46	7%
6.2 Admin-Log computer	0.19	0.38	45%
6.3 Admin-Print notes	0.05	0.70	6%
Mean	0.13	0.46	23%

It was expected, for the reasons given above, that the triage logging subtask (6.2) would be among the most interrupted. That subtasks 1, 2.1 and 2.2 were often interrupted was also not surprising given the qualitative finding that the beginning of the triage often involved a lot of switching – and since nurses were very visible and accessible to others when they performed these activities (AE2FN 2; AE3FN 1). It was however surprising that ‘taking observations’ (subtask 2.1) was the most interrupted subtask. Qualitative analysis however, helped to explain this: fieldnotes recorded that the task was automated in large part (e.g. nurses used machines such as blood pressure and oxygen saturation monitors), meaning that nurses were able to commence other tasks while they waited for a particular reading to be returned by a machine (AE3FN 1; AE4FN 1).

Table 6-11 shows the average number of times (per hour) that nurses switched from the primary task – listed in the rows – to the secondary task – listed in the columns. The data show, for example, that nurses switched from the paramedic handover (subtask 1) to questioning the patient (subtask 2.1) 1.2 times per hour on average. The most frequent switches are highlighted in yellow, with the intensity of the colour proportionate to the switching frequency.

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<sup>43</sup> Subtasks 3 and 4 were excluded from this analysis due to their very low frequency.

Table 6-11 Mean switching frequencies (per hour)<sup>44</sup>

Secondary Task (columns) Primary Task (rows)	1	2.1	2.2	5	6.1	6.2	6.3	Non HTA	TOTAL
1 Paramedic handover	0.1	1.2	1.3	0.6	0.1	0.0	0.0	0.5	4.08
2.1 Take observs	0.8	0.0	0.6	0.3	0.1	0.0	0.0	0.1	2.23
2.2 Question patient	0.6	0.5	0.0	0.3	0.0	0.0	0.0	0.2	2.02
5 Move patient	0.5	0.1	0.0	0.0	0.4	0.3	0.1	0.9	2.37
6.1 Admin-Enter pin	0.3	0.0	0.0	0.1	0.2	0.5	0.0	0.4	1.53
6.2 Admin-Log computer	0.2	0.1	0.0	0.0	0.3	0.6	1.0	2.0	3.91
6.3 Admin-Print notes	0.1	0.0	0.0	0.0	0.0	0.1	0.6	0.9	1.74
Non HTA	1.2	0.3	0.0	0.3	0.5	2.5	0.2		9.10

The data presented in Table 6-11 helped to confirm several of the findings highlighted by the ‘interruption’ and ‘task part’ analyses. That the paramedic handover (1), patient assessment (2.1 and 2.2), and triage logging (6.2) subtasks were often fragmented, for example, was consistent with the previous analyses.

As well as confirming previous findings, the switching frequency analysis also helped to explain these findings – especially when combined with further insights from the qualitative fieldnotes. Focusing on subtasks 1, 2.1 and 2.2 again, it is possible to see that nurses grouped the tasks together (after completing subtask 1, 2.1 or 2.2, nurses frequently commenced one of the other two subtasks). Close examination of qualitative fieldnotes helped to explain why; the notes recorded that all three tasks supported the same basic goal – to gather information to inform the initial patient assessment (AE1FN 1; AE2FN 2) – hence they could be considered interdependent.

Further explanation of previous findings was also derived through careful analysis of switching data. In terms of the finding that the triage logging subtask (6.2) was often fragmented, for example, Table 6-11 suggests that this was frequently attributable to the need to perform unplanned (non HTA) tasks. This

<sup>44</sup> Subtasks 3 and 4 were excluded from this analysis due to their very low frequency.



supports – and indeed helps to quantify – the aforementioned assertion that nurses were often interrupted by clinicians' questions when performing this subtask (i.e. and hence they had to perform the task in a somewhat 'stop-start', staccato, manner).

The switching frequency analysis, together with additional qualitative notes, also help to explain the earlier finding that nurses spent a large amount of time performing unplanned (non HTA) tasks (e.g. see Figure 6-9, page 260). Table 6-11 shows that nurses performed such tasks throughout the triage, rather than only at one or two specific points during the triage. This finding was echoed in the fieldnotes, where it was attributed to the frequent need to perform triage 'follow up tasks' (i.e. tasks that were related to a patient triage, but which were not included in the standard task template provided by the HTA; AE2FN 1). Such tasks included seeking urgent medical attention for patients, ordering important tests, getting a blanket for a patient. So, while nurses spent a lot of time – almost half of their shift according to Figure 6-9 (page 260) – performing unplanned (non HTA) tasks, many of these were in fact related to the triage, and most involved recognised 'nursing' jobs (i.e. patient care tasks that clinicians would normally expect nurses to do).

As well as aiding the interpretation of previous findings, the switching frequency analyses helped to identify several new ones. The most interesting of these concerned not just the micro aspects of nurses' switching behaviour, but more macro issues regarding how they structured their work during the triage.

The data in Table 6-11, above, suggest that nurses' task management was heavily shaped by the intrinsic constraints of the task, including the sequential

dependencies highlighted in the HTA (e.g. the need to assess patients, by completing subtasks 1 to 2, before administering the triage at 6.1–6.3). Nevertheless, the switching analysis, together with qualitative insights, suggested that nurses adapted to the HTA task requirements, by performing the triage in two distinct phases – as depicted in the HTA diagram in Figure 6-20. Nurses appeared, very often, to complete subtasks 1 – 5 ('Phase One' in Figure 6-20) in a single 'block', with minimal breaks; they then tended to switch to other patient-tasks, before completing the triage administration subtasks (6.1–6.3; 'Phase Two' in Figure 6-20), later (AE5FN 2; AE6FN 1).

To verify this finding, the switching frequency data displayed in Table 6-11 were subjected to further quantitative analysis. This attempted to establish the probability of nurses' switching from a Phase One or Phase Two subtask – or from a unplanned (non HTA) task – to a subtask that was part of another phase. The results are described in Table 6-12.<sup>45</sup> The overall pattern was clear: nurses were far more likely to switch to a subtask within the same phase, supporting the notion that nurses performed the task in distinct phases.

*Table 6-12 Task phase switching probabilities*

	Phase 1	Phase 2	Non HTA	Total
Phase 1	0.71	0.08	0.21	1.00
Phase 2	0.16	0.42	0.42	1.00
Non HTA	0.22	0.34	0.43	1.00

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<sup>45</sup> The following procedure was followed to obtain the switching probability figures presented in Table 6-12. Switching probabilities for each of the Phase One and Two subtasks were first calculated by dividing the switching frequency data (in Table 6-11), for each subtask, by the total number of switches emanating from the primary task. The resulting figures were then recoded according to the task phase – or task type – to which they belonged.

As before, the qualitative fieldnotes help to explain nurses' behaviour. By completing all of the Phase One subtasks in one block (i.e. without a break), nurses could keep detailed patient information in mind while they conducted the initial patient assessment (AE6FN 1). This minimised competing demands for a period, and allowed nurses to concentrate on making the best possible decision regarding how to manage each triage-patient (e.g. whether to send the patient to majors or minors; AE6FN 1).

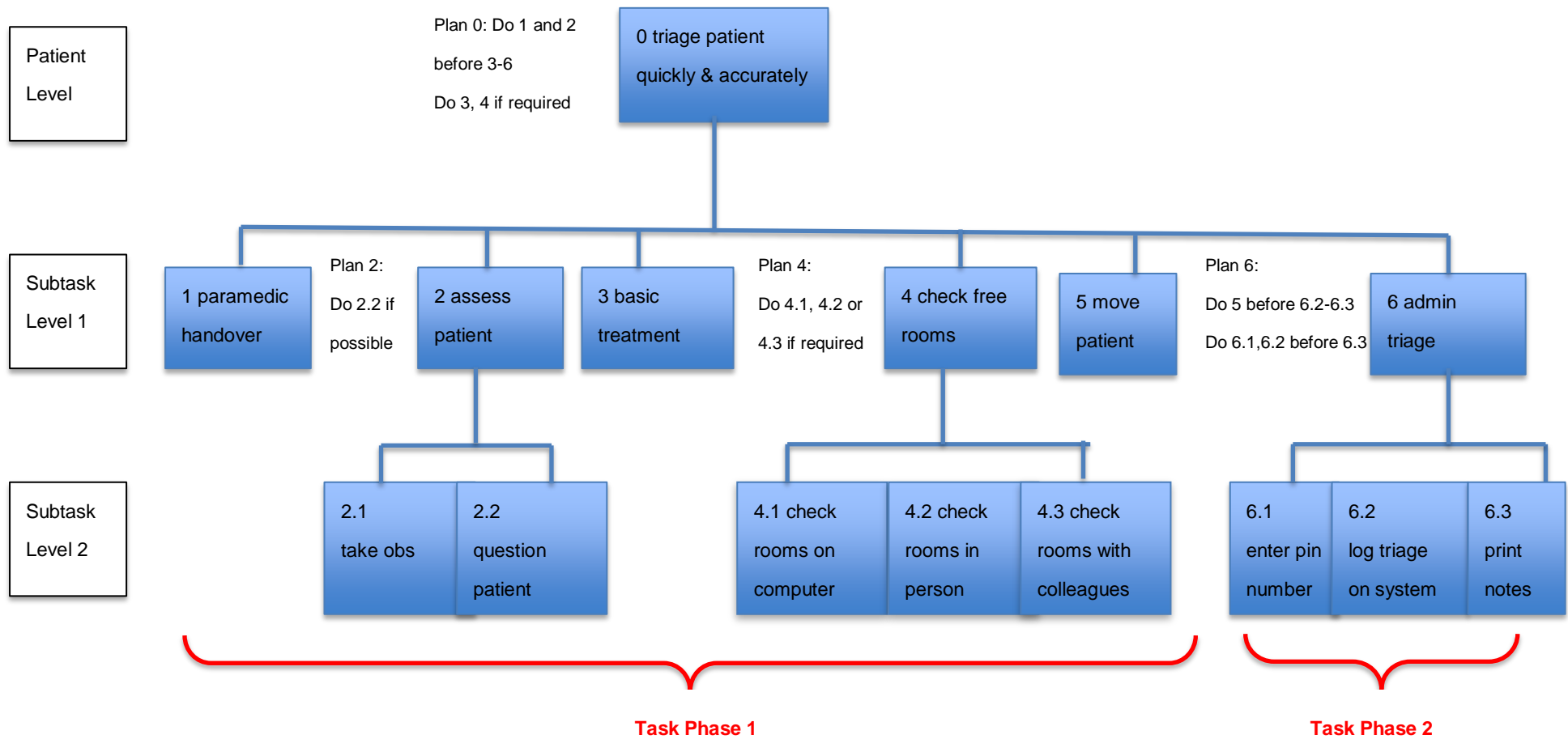


Figure 6-20 Hierarchical task diagram for ambulance triage task – with task phases

Performing the task in phases also provided flexibility, and allowed nurses to prioritise and respond to the unpredictable demands of the triage (AE5FN 1; AE6FN 1). When faced with a queue of patients waiting for triage, nurses almost always completed Phase One *for all patients* before commencing Phase Two *for any of them* (AE5FN 1). This ensured that patients were never left waiting for a long time for an initial assessment.<sup>46</sup>

A final benefit of performing the task in phases was that it allowed nurses to group tasks requiring similar resources, so these could be performed at the same time. This reduced the requirement to switch among different tools, technologies, or locations – or indeed among different modes of thinking (AE6FN 2).<sup>47</sup>

Other factors – including the delays that were sometimes experienced in patients being ‘booked on’ to the computer system by the reception – and the need to meet targets regarding the patient handover time (from the ambulance to A&E) – might also have effected nurses’ tendency to perform the triage in phases.

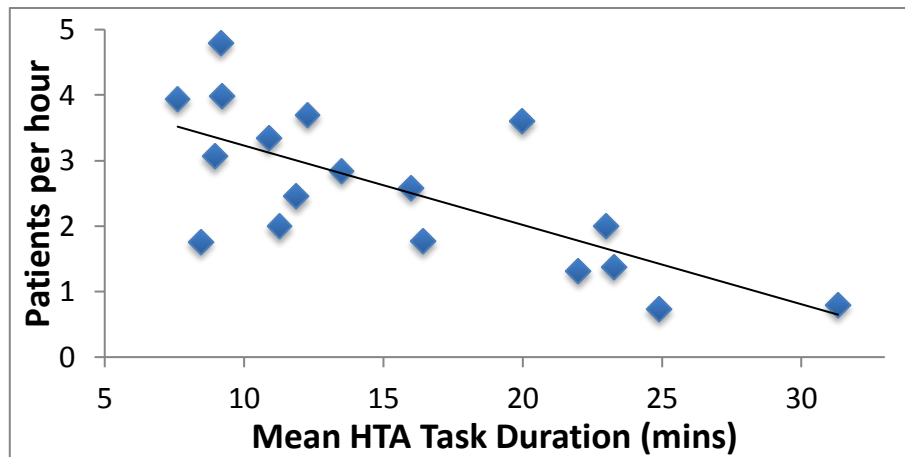
Figure 6-21 and Figure 6-22, below, examine nurses’ adapting in the context of high and competing demands. Figure 6-21 illustrates the association between the patient volume (the number of patients arriving for triage, per hour), and the

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<sup>46</sup> It is worth recalling here that face-to-face conversation remained the dominant mode of communication in A&E – hence short delays in administering the triage were unlikely to have serious consequences for patient care.

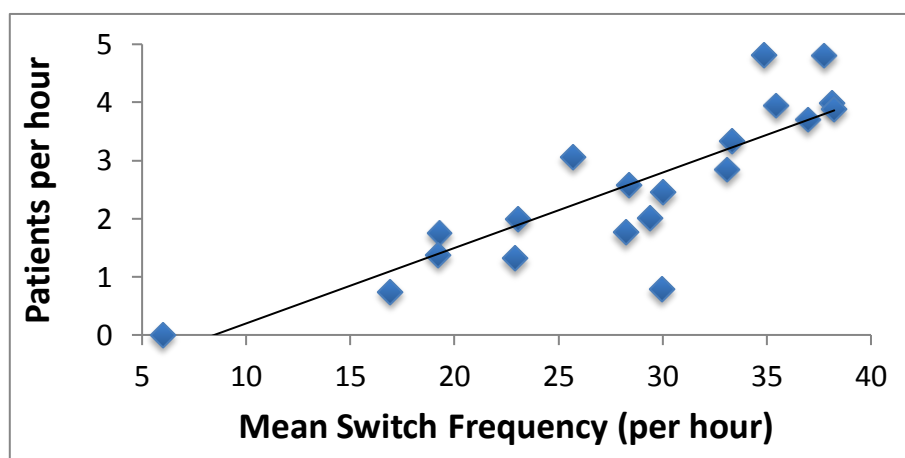
<sup>47</sup> Focusing on the switching frequency analysis (Table 6-11), the tendency to group similar tasks could be observed in nurses’ repeating the same subtask, but for different patients. (This behaviour can be observed in the diagonal running from top left to bottom right of Table 6-11). Nurses did this especially often in the case of two of the triage administration subtasks, 6.2 and 6.3, and the qualitative notes were again able to explain this: nurses often logged multiple triages at the same time, and they frequently printed numerous patients’ notes all at once, in order to avoid making repeat visits to/ from the computer station and the printer respectively.

mean task duration, for each of the 21 observation sessions. The relationship is negative in valance, and of moderate-high strength. This might suggest that nurses adapted to increased demands by conducting the triage more quickly.



*Figure 6-21 Scatterplot of HTA triage task duration and patient volume*

Figure 6-22 depicts the relationship between patient volume and task switching frequency (a measure of work fragmentation). The strong, positive association indicates that nurses switched more often – and hence their work was more fragmented – when they had more patients to triage.



*Figure 6-22 Scatterplot of task switching frequency and patient volume*

### **6.3.2.2 Surgical Ward Drugs Round**

Figure 6-23 depicts mean subtask frequencies (per round) while Figure 6-24 presents their mean durations. The subtasks depicted in the charts represent the most detailed possible view of the HTA task. Those subtasks denoted by an integer on the x-axis label (e.g. subtask 2, 'ID patient') were broken down at subtask level 1 in the HTA (Figure 6-4, page 249), while those denoted by a decimal number were described at subtask level 2.

Unsurprisingly, the most frequent subtasks were those that supported the preparation and administration of oral and IV/IM drugs. Less expected was how rarely three particular subtasks – namely the medications double check (subtask 3), identifying patients and checking allergies (subtask 2) and updating the drug chart (subtask 5) – were performed.

Regarding the medication check, the main reason this was performed only rarely, the fieldnotes suggested (SU3FN 1), was that the researcher observed only a small proportion of IV drug administrations – especially the more complex ones – which were more likely to require a double check (i.e. when compared with oral drugs, that were most observed).<sup>48</sup> Another possibility, which occurred on at least one occasion, is that nurses administered controlled drugs (which required mandatory checks) before the start of the agreed observation time. Nurses admitted to doing this on more than one occasion, explaining it in terms of the need to prioritise giving these drugs (SU8FN 1; SU2FN 1) – although it is also possible that nurses feared negative evaluation in being observed (SU6FN 1). A

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<sup>48</sup> The researcher observed only a small proportion of IV drug administrations since these – especially the more complex ones – were frequently prepared outside of the observed rounds (e.g. they were frequently completed by night staff before they finished their shifts).

final possibility is that nurses omitted the medication check altogether, but no specific evidence was obtained to support this.<sup>49</sup>

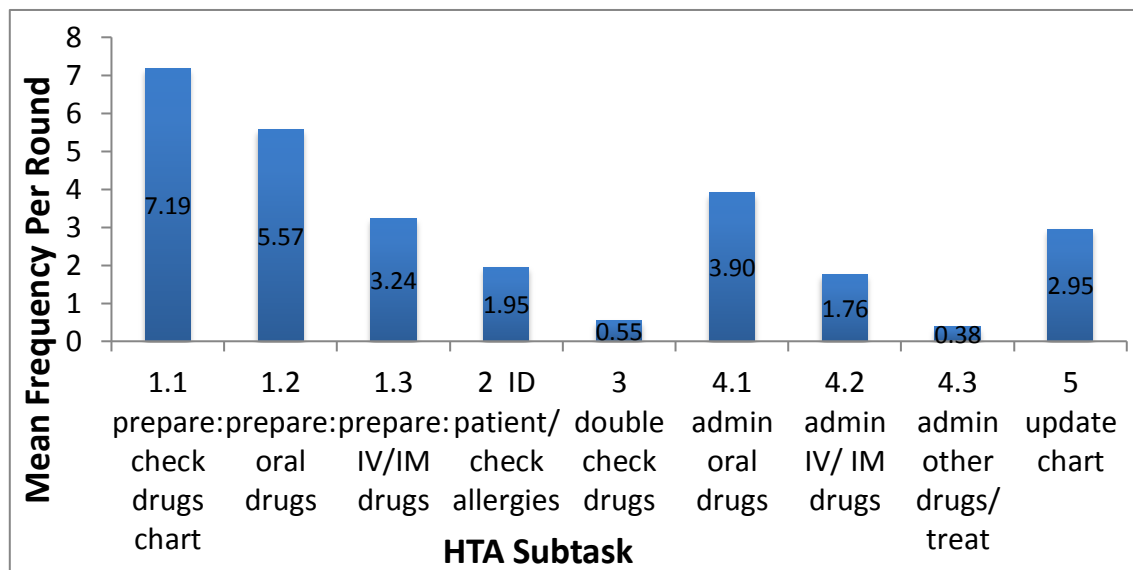


Figure 6-23 Mean HTA subtask frequencies per round

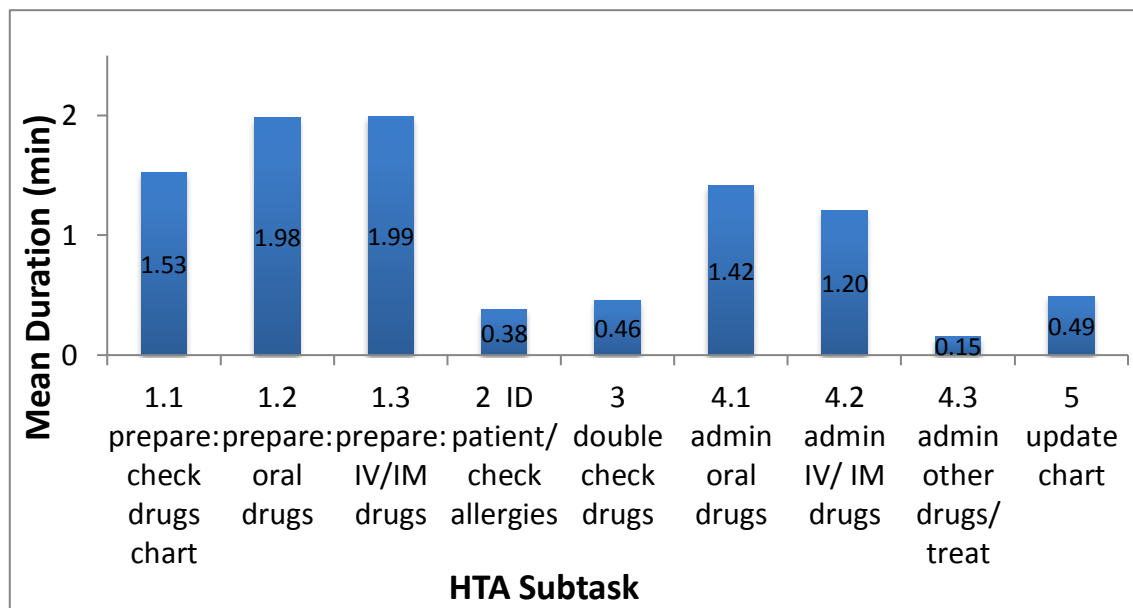


Figure 6-24 Mean duration of HTA subtasks<sup>50</sup>

49 Note: subtasks were counted each time they were commenced, regardless of whether they were finished or not.

50 The subtask durations depicted in Figure 6-24 capture the total amount of time spent by the nurse on the subtask, for an 'average patient'. Where the nurse stopped and started the task multiple times (for the same patient) the figures represent the sum of the nurse's time spent working on the subtask.



Similar explanations might account for the relative infrequency of identifying patients and checking allergies (subtask 2; e.g. SU4FN 1; SU5FN 1). However, an additional explanation for this was obtained directly from one nurse, who admitted that she sometimes omitted subtask 2 in the afternoon and evening rounds (SU5FN 1). Her reasoning was that she felt confident in her ability to remember the patient's identity throughout the day (without having to check during each round). While this represented a violation of clinical protocols, it did not appear unsafe as such.

Regarding nurses' updating the medications chart (subtask 5), Figure 6-23 indicates that this was performed around 3 times per round – despite nurses having more than 4 patients to treat on average. The reasons given above to explain the infrequency of the other subtasks might apply again here, although it is not clear which might be most important (SU8FN 1). Another possibility is that this task was among the quickest subtasks, and might have been missed by the researcher on occasion.

The Multitasking Patient Index (MPI) computed for the A&E triage data was not calculated for the surgical ward medications round for several reasons. These include that the medications rounds – and therefore observation sessions – were relatively short in duration (they were scheduled to last one hour), and they were 'temporally discrete' (meaning that rounds were separated in time by several hours, or more).<sup>51</sup> Because of this, medications tasks – unlike A&E triage tasks – were not generally 'carried over' by nurses for long periods. A second reason, which is discussed further below, is that nurses rarely managed rounds

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<sup>51</sup> Rounds began at 8am, 12pm and 6pm.

concurrently – hence there was very little ‘concurrent patient management’ to consider.

Table 6-13 presents the mean number of HTA ‘task parts’ – the number of times each subtask was performed, during an average patient round – a measure of work ‘fragmentation’. The results suggest that the three drug preparation subtasks (1.1 to 1.3) were, by some distance, the most fragmented, with each being performed, on average, in around two parts each round. It is interesting to note, nevertheless, that the three drug administration subtasks (4.1 to 4.3) were also performed over multiple ‘parts’ on *some* occasions. Nurses had suggested that they did not like to do this, for safety reasons (e.g. SU5FN 1).

*Table 6-13 Mean number of HTA task parts<sup>52</sup>*

HTA Subtask	Mean no. Task parts	S.D.
1.1 prepare: check drugs chart	1.94	1.23
1.2 prepare: oral drugs	1.95	1.37
1.3 prepare: IV/IM drugs	1.74	0.82
2 ID patient/ check allergies	1.05	0.22
4.1 admin oral drugs	1.34	0.64
4.2 admin IV/ IM drugs	1.37	0.63
5 update chart	1.07	0.26
Mean	1.53	0.99

Table 6-14 shows the proportion of HTA subtasks that were interrupted, and the number of interruptions *per primary task minute*.

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<sup>52</sup> The analysis describes the mean number of task parts *whenever the subtask was actually performed* – hence the minimum number was 1. Subtasks 3 and 4.3 were excluded from this analysis due to their very low frequency.

Table 6-14 Number and percent of HTA tasks interrupted<sup>53</sup>

HTA Subtask	Mean no. interrupts (per primary task min)	SD	Percent interrupted
1.1 prepare: check drugs chart	0.51	1.17	45%
1.2 prepare: oral drugs	0.31	1.18	46%
1.3 prepare: IV/IM drugs	0.15	0.64	40%
2 ID patient/ check allergies	0.07	0.15	5%
4.1 admin oral drugs	0.16	0.53	24%
4.2 admin IV/ IM drugs	0.09	0.37	25%
5 update chart	0.08	0.20	6%
Mean	0.13	0.69	36%

That the drug preparation subtasks were most interrupted – and performed over the most ‘task parts’ – was consistent with data from iLogger, and with fieldnotes, which suggested that nurses frequently interleaved drug preparation activities (SU1FN 1). In particular, nurses regularly checked the drugs chart (subtask 1.1) while making up patient medications (1.2 and 1.3) – apparently because checking the chart supported the completion of the latter activities. Key reasons for this, according to fieldnotes, included that the chart provided a memory aid, and allowed the nurse to understand the role of a particular medication in the context of the patient’s overall regimen (SU4FN 2; SU3FN 1). The latter was important because it allowed nurses to better appreciate the patient’s condition, while it also facilitated error-checking regarding patient prescriptions (SU4FN 2).

Other reasons for switching during drug preparation related to the need to deal with adhoc questions from patients and colleagues (SU1FN 1; SU1FN 2). HDU nurses were especially likely to be interrupted by patients while preparing drugs, since they, unlike their colleagues on the main surgical ward, made up medications within their own bay (SU1FN 2). Patients could thus see the nurses, and easily call over to them (SU1FN 2; SU4FN 1). Nurses working on the main

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<sup>53</sup> Subtasks 3 and 4.3 were excluded from this analysis due to their very low frequency.

ward, in contrast, were more likely to face questions from other colleagues – especially queries relating to medication tasks – when preparing drugs. It should be noted however that nurses avoided interruptions during some drug preparation activities e.g. performing complex dosage calculations (SU5FN 1).

While nurses often interrupted drug *preparation* subtasks, they generally avoided interruption during the drug *administration* activities e.g. by frequently deferring tasks until they had completed a current subtask (SU3FN 1). However, Table 6-14 shows that nurses did, on occasion, interrupt giving medicines, which was surprising given that many nurses suggested this was unsafe – and because it violated clinical protocols (see HTA, Table 6-5). To qualify this point, it is worth noting that nurses' interrupting did not necessarily appear unsafe; nurses never interrupted half way through giving a single drug, rather they waited until the individual had consumed the full dose of each medicine before switching. (This may be considered akin to nurses' finishing a subtask before switching; SU6FN 1; SU8FN 1).

The qualitative fieldnotes, as well as the quantitative task duration data (see Figure 6-24), help to explain why the 'patient identification' (subtask 3) and 'drug chart updating' (subtask 5) subtasks were interrupted least. Both were relatively quick jobs, taking less than 30 seconds on average, hence there was less opportunity – and perhaps less need – to interrupt (SU6FN 1).

Table 6-15 shows the average number of times (per hour) that nurses switched from the primary task – listed in the rows – to the secondary task – listed in the columns.

Table 6-15 Mean switching frequencies (per hour)<sup>54</sup>

Secondary Task (columns) Primary Task (rows)	1.1	1.2	1.3	2	4.1	4.2	5	Non HTA	TOTAL
1.1 prepare: check drugs chart	0.1	2.2	0.9	0.3	0.2	0.1	0.1	1.2	5.10
1.2 prepare: oral drugs	0.9	0.1	0.1	0.5	0.9	0.0	0.1	1.2	3.97
1.3 prepare: IV/IM drugs	0.5	0.1	0.1	0.2	0.1	0.3	0.0	0.9	2.36
2 ID patient/ check allergies	0.0	0.1	0.0	0.0	0.7	0.3	0.0	0.1	1.40
4.1 admin oral drugs	0.4	0.2	0.0	0.0	0.0	0.0	0.9	1.0	2.60
4.2 admin IV/ IM drugs	0.2	0.0	0.1	0.0	0.0	0.1	0.3	0.5	1.23
5 update chart	0.7	0.0	0.0	0.0	0.1	0.0	0.0	0.9	1.78
Non HTA	1.8	1.1	1.0	0.3	0.6	0.4	0.3	5.7	11.34

The switching frequency analysis helped to confirm existing findings, and provided new insights. The earlier finding that nurses switched frequently among the drug preparation subtasks (1.1 to 1.3) is confirmed, while an additional insight was that nurses' were especially likely to transition to/ from checking the drugs chart (1.1) and preparing oral medications (1.2). This might be explained however by the high baseline switching frequency to/ from the oral drug preparation subtask (1.2), rather than an increased *probability* of transitioning to this activity.

Another novel finding obtained from the switching frequency analysis concerned the timing of subtask 2 (where 'timing' refers to the point at which, in the context of the task as a whole, the subtask is performed). Clinical protocols did not specify precisely when this should happen, but Table 6-15 indicates that it was usually done immediately before giving drugs (4.1 or 4.2). It might be that checking IDs at the point of drug administration enabled a safer routine (e.g. because nurses would have been less reliant on their memory regarding patient identities; SU3FN 1; SU8FN 1). This provides further evidence of nurses' adapting, to maximise desired outcomes.

<sup>54</sup> Subtasks 3 and 4.3 were excluded from this analysis due to their very low frequency.

Further insights obtained from the switching frequency analysis concerned how nurses handled unplanned tasks alongside their medications tasks – with particular reference to when specific tasks were performed, in the context of the round as a whole. Table 6-15 indicates that nurses were more likely to deal with unplanned (non HTA) tasks after updating the drugs chart (subtask 5), and less likely to do this after checking the chart (1.1).<sup>55</sup> This would make sense given that subtask 5 marked the end of the drugs round, while subtask 1.1 represented the beginning of the task i.e. since nurses displayed a tendency to avoid interruption, where possible.

Other findings regarding nurses' management of unplanned tasks included a clear tendency to group unplanned tasks together (i.e. to perform them consecutively, one after the other). This finding was noted in the qualitative fieldnotes, and it was explained by the benefits it afforded nurses in simplifying task management (SU5FN 2). More specifically, grouping unplanned tasks together reduced the need to interleave such activities with the medications HTA subtasks, which nurses considered unsafe (SU5FN 2).

Further analysis of the switching frequency data in Table 6-15 were conducted to determine whether distinct phases of the drugs round HTA task – and nurses' other work (i.e. unplanned tasks) – could be identified. Earlier findings pointed to one such potential phase, relating to the drug preparation subtasks (1.1–1.3), while the finding that nurses managed unplanned tasks separately from the medications round might imply another distinct phase. The additional analysis therefore investigated the probability of nurses' switching among tasks within the

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<sup>55</sup> Appreciating this point requires comparing the relative frequency of the 'unplanned' and 'total' columns in Table 6-15.

following three phases: phase 1) drug preparation (subtasks 1.1–1.3), phase 2) other HTA subtasks (subtasks 2–5), and phase 3) unplanned tasks (non HTA).<sup>56</sup> (The HTA diagram in Figure 6-25 depicts the first two of these phases). The results are presented in Table 6-16.<sup>57</sup>

*Table 6-16 Task phase switching probabilities*

	<b>Phase 1</b>	<b>Phase 2</b>	<b>Non HTA</b>	<b>Total</b>
<b>Phase 1</b>	0.67	0.03	0.30	1.00
<b>Phase 2</b>	0.49	0.20	0.31	1.00
<b>Non HTA</b>	0.34	0.15	0.51	1.00

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<sup>56</sup> To be precise, the analysis examined the probability of nurses' switching from a Phase One or Phase Two subtask – or from a non HTA task – to a subtask that was part of another phase.

<sup>57</sup> The following procedure was followed to obtain the switching probability figures presented in Table 6-16. Switching probabilities for each of the Phase One and Two subtasks were first calculated by dividing the switching frequency data (in Table 6-15), for each subtask, by the total number of switches emanating from the primary task. The resulting figures were then recoded according to the task phase – or task type – to which they belonged.

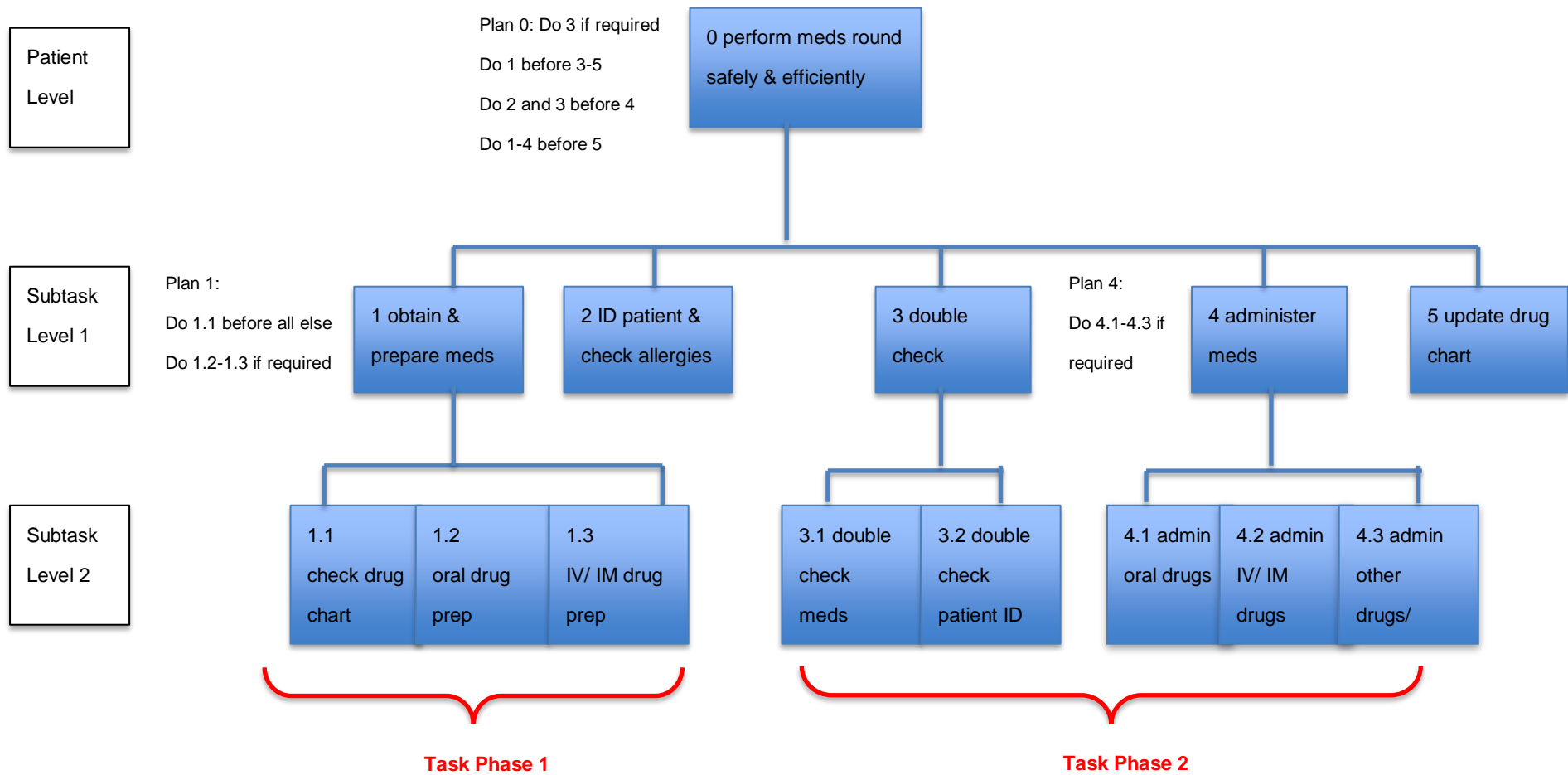


Figure 6-25 Hierarchical diagram: medications round (surgical ward) – with task phases



The switching probability data confirm the existence of a distinct 'drug preparation' phase (phase 1 in Table 6-16), since nurses only rarely switched to another non preparation activity. The notion that unplanned (non HTA) tasks would represent a distinct phase was supported to some degree, as nurses were rather more likely to switch to another non HTA task than to any other type of task. Phase 2 however was not a distinct phase at all; nurses were very likely to interleave phase two subtasks with activities from other phases. Given the patterns observed in the switching frequency data (Table 6-15), this might be explained by nurses' tendency to continue checking the drugs chart throughout phase 2.

Figure 6-26 and Figure 6-27 examine nurses' adapting to high and competing demands. Each of the charts depicts the relationship between key variables pertaining to such demands, for each of the 21 observation sessions.

Figure 6-26 illustrates the association between patient volume (the number of patient rounds performed) and the mean drugs round duration. This analysis was problematic (e.g. since there was very limited variance in patient volume), but little or no meaningful relationship was observed.

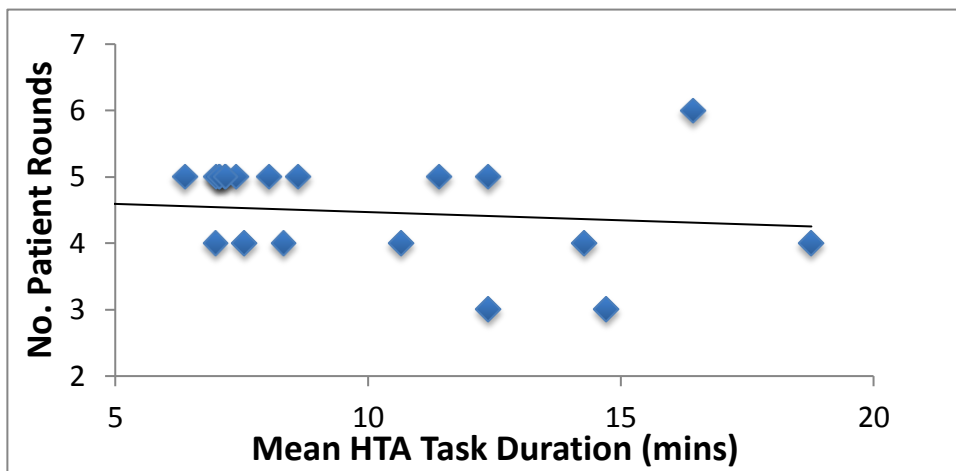


Figure 6-26 Scatterplot of HTA triage task duration and patient volume

Figure 6-27 depicts the relationship between task switching frequency – a measure of work fragmentation – and patient volume. The moderate, positive association indicates that nurses switched more often – and hence that their work was more fragmented – when they had more patient rounds to perform.

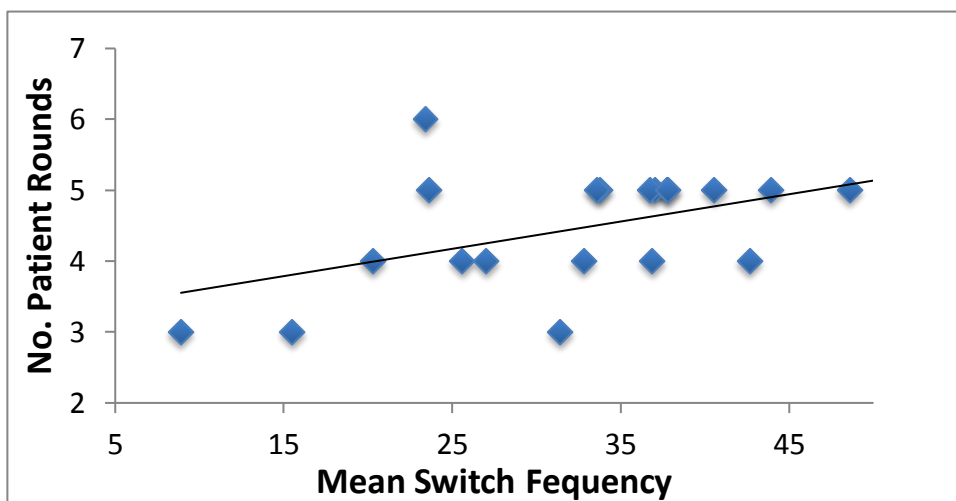


Figure 6-27 Scatterplot of task switching frequency and patient volume

### 6.3.2.3 Summary and Comparison

A summary of the main findings of the task switching and multitasking analysis, together with a comparison between the study settings, is provided in Table 6-17.

*Table 6-17 Main findings of the task switching and multitasking analysis*

- The Multitasking Patient Index (MPI) showed that A&E nurses spent more than 70% of their time multitasking patients. The MPI was not computed for the surgical ward.
- A number of HTA subtasks in both settings were highly fragmented and interrupted frequently. A key reason for this was that many subtasks were interdependent (meaning that either required input from other subtasks – or that they facilitated the completion of other subtasks). Another reason, especially apparent in A&E, was that some subtasks were automated, which encouraged nurses to commence other activities while they waited for an (automated) task to be completed.
- In both settings, nurses were more likely to face interruptions when they performed tasks that required them to be visible and/or more accessible to other staff and patients.
- Also in both settings, nurses tended to avoid interruptions at certain times – especially when performing safety-critical tasks.
- Various sequential task requirements, also affected nurses' behaviour. While some of these were intrinsic to the task, others were adaptations designed to support safety or efficiency in some way e.g. surgical nurses checked patient's ID immediately before administering medications, as this seemed safer than doing it at another time.
- Nurses in both settings interleaved unplanned tasks with the HTA task. However, this was far less common during the surgical medications round – likely because of the potential safety implications.
- Nurses in both settings grouped subtasks together, such that the HTA task had distinct 'phases'. This provided a number of advantages: it allowed interdependent tasks to be performed concurrently, it provided the ability to respond flexibly to events, and it reduced the requirement to switch among different technologies or locations.
- Bivariate analysis of nurses' adapting to high and competing demands provided some (albeit limited) evidence that nurses worked faster, and switched tasks more often, when patient volume was higher.

### **6.3.3 Timeline Analysis of Specific Episodes of Competing Demands**

The current section is divided into two subsections. The first presents an example of one of the four detailed analyses (per setting) that were conducted to illuminate nurses' handling of the specific episodes of competing demands, while the second summarises what was learned through analysis of all of the episodes (i.e. it is an aggregated analysis). To be clear, the data used in the timeline analysis was a combination of interview and observation data (although most of the data presented below relate to interview data, since this was more compelling). The reason for presenting example timelines, rather than presenting only an aggregated analysis, is that the latter could not, on its own, provide the rich, contextualised understanding that the study seeks to contribute.

#### **6.3.3.1 Example Timelines**

##### **Accident & Emergency Ambulance Triage**

The example episode lasted 90 minutes, and is depicted in the HTT diagram in Figure 6-28. The three coloured (or greyed-out) rows in the diagram correspond to the three levels of the HTA diagram presented in Figure 6-3 (page 246). The top row refers to the Patient Level of the HTA – hence the numbers represent different patients. The middle and bottom rows relate to subtask levels 1 and 2 of the HTA, and the non-red colours represent different HTA subtasks. Red blocks represent unplanned tasks (described as 'Non HTA' on Figure 6-28), while the

check pattern highlights delegated tasks.<sup>58,59</sup> Finally, the bold text boxes highlight the arrival of a new ambulance/ patient for triage.

The episode occurred in the late morning while a junior nurse (aged 27, less than one year since qualifying) was being observed. The nurse had started her shift at 10AM and had been performing the triage for two hours when the incident began. She had been busy in the morning, but by the beginning of the episode she had 'caught up' with her workload (AE8FN 1).

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<sup>58</sup> What is actually being depicted by the check pattern, in almost all cases, is the nurse either looking for a colleague to delegate to, or explaining to such an individual what is required of them.

<sup>59</sup> The black, vertical lines dividing the red blocks on subtask level 2 indicate that the nurse has switched from one unplanned task to another.

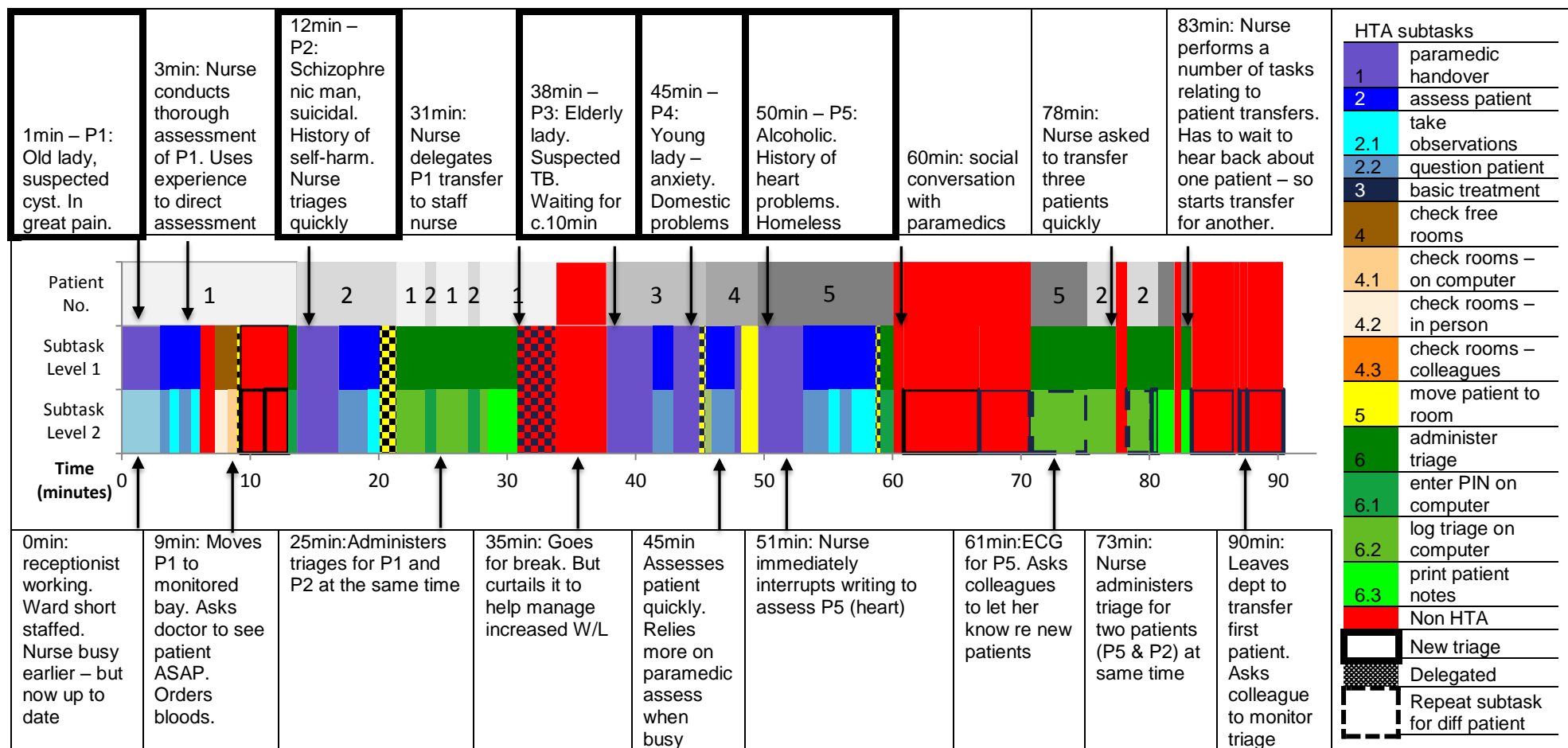


Figure 6-28 Hierarchical Task Timeline Example for A&E

The main demands faced by the nurse related to the volume of patients (i.e. patients arriving for triage), the complexity of several patient cases, and short staffing. The need to perform unplanned tasks, the lack of predictability over the timing of tasks – especially urgent ones – and the unequal distribution of work requirements over the 90 minute period, also contributed to demands (AE8FN 3).

The nurse triaged five patients during the episode – all of whom arrived within the first 50 minutes. The first two patients arrived within the first 12 minutes – while the latter three arrived within 13 minutes of each other (38 through 50 minutes on Figure 6-28). Three patients (P2, P4 and P5; at 13, 47 and 53 minutes) arrived before the nurse had finished assessing the previous patient.

*There was a period when I took over in the afternoon where we had several ambulances arriving at the same time, plus the need for several... movements of patients. AE8INT, 1,12*

New triages, and many unplanned tasks, were often unpredictable in their timing, and they frequently required urgent attention. The requirement to transfer several patients (78 through 90 minutes on Figure 6-28), for example, arose spontaneously, and had to be addressed quickly.

*So those [referrals for P1 and P2] were quite tricky because they came in quite quickly. Then there was a period with the gentleman who was escorted in with the police. AE8INT, 2,76*

Many unplanned tasks related to 'follow up' activities from previous triages (AE8FN 1). For example, the nurse conducted ECG tests for triaged patients (61 minutes, 80 minutes), and she alerted medical staff when patients needed urgent attention (10 minutes). Other unplanned tasks resulted directly from short staffing. The transferring (e.g. 31 minutes) and referring of patients to other wards (e.g. 9 minutes), for example would usually be performed by a staff nurse – but the lack of nurse numbers meant that the triage nurse was required to help with this.

*It was one of those funny days where had we been fully staffed, it would have been... fine but you get these periods where you have an influx of ambulances, or you're being asked to transfer patients, because we don't have enough staff...*

*AE8INT, 1,26*

The nurse spent more time assessing patients who had complex illnesses. The first patient (P1), for example – an elderly lady who had symptoms several distinct diseases – was assessed thoroughly, and the nurse disagreed with the assessment of the paramedic who brought her. (The total time spent triaging this patient, just over 17 minutes, was 30% longer than that taken for any other individual).

*So I took the assessment from the ambulance but... There were a couple of things that didn't quite match up... like they'd written down that she had cystic fibrosis but for a 75 year old to have cystic fibrosis is unusual, plus her oxygen stats were fine... so you kind of think well what have they misunderstood?*

*AE8INT, 3,123*



In assessing patients, the nurse engaged in considerable sensemaking (making sense of contextual information to understand and anticipate a situation).<sup>60</sup> She used subtle cues regarding patients' social and psychological situation (e.g. how well the patient looked after themselves, whether they had friends or family available to them) to consider the level of need, and to prioritise (AE8SHA 5,19; P1, 3 minutes).

The nurse admitted that she kept a mental 'to do' list to keep track of competing demands, while she claimed that these demands accumulated most during the early part of the episode i.e. when multiple patients arrived in a short period (AE8SHA 2,11; AE8SHA 4,11).

To ensure important and urgent jobs (including unplanned tasks) were completed, without abandoning other tasks, the nurse had to switch frequently among different patients/ jobs – and she often performed tasks in multiple 'parts' (AE8FN 3). Figure 6-28 shows, for example, that the nurses' administering of P2 was completed in several parts – and took place over a period in excess of one hour.

The nurse received support from colleagues on a number of tasks. She asked a staff nurse to transfer a patient to another ward (31 minutes on Figure 6-28); she asked her colleagues to help to monitor the triage desk for any new patient arrivals (e.g. 61 minutes); and she relied on paramedics to help move individuals, and to support patient assessments (e.g. by using information obtained by

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<sup>60</sup> See Concept Development chapter, section 5.1.3.2, for a more detailed description of sensemaking.

paramedics to aid her evaluation; 45 minutes). The nurse also received help from a receptionist who had been posted to the triage desk to book patients on to the computer system (1 minute).

The charge nurse reduced competing demands by communicating well and organising work efficiently (AE8FN 4). She also helped the nurse in assessing patients – and in covering the triage when competing demands became excessive (AE8INT,4,182; 5,212).

The nurse felt that maintaining awareness of competing demands, as well as the ability to interrupt, were important, as this allowed rapid responding in an emergency – and the prioritising of patient tasks (AE8INT,1,46; 9,458).

While maintaining awareness was considered important, high (competing) demands meant the nurse was unable to monitor patients regularly in person (AE8FN 2). To compensate, the nurse placed particularly unwell patients (e.g. P1 and P2; 9 and 12 minutes) in one of the cubicles nearest the charge nurse area. Patients in these rooms could be seen and heard more easily, allowing staff to better monitor them – and to respond appropriately.

*So then I decided to put her [P1] into one of our monitored cubicles, the one next to the nurses' station because I thought it was appropriate to have her somewhere where we could keep an eye on her. AE8INT,9,419 (see 9 minutes)*

Another adaptation that supported awareness was frequent communication among healthcare staff. The nurse spent a large proportion of her shift in, or

close to, the charge nurse area, and she frequently updated colleagues regarding recent developments – and she received many updates herself (e.g. 9 minutes).

The nurse was observed, on a number of occasions, prioritising tasks that might save time, or reduce demands in some respect, later (AE8FN 1). The nurse acknowledged this was a conscious strategy, and pointed to her handling of patient referrals (9 minutes; 78 minutes) to exemplify this.

*So the things that can be done immediately that will make a difference in the long term [those are the ones we plan to do first]. So, for example, the referrals, you want to get them done straight away... it can take a long time to get a response... it could cause a delay if you do not prioritise these AE8INT,3,145*

The nurse implies (above) that planning and anticipating, together with the ability to respond quickly, might reduce competing demands later on. Examples regarding how such strategic behaviours might achieve this related to the nurse's ordering blood tests for one patient (P1; 9 minutes), and seeking urgent treatment for another (P5), to prevent his condition from deteriorating.

*[After assessing P5] I went straight away and got the doctor to write up some drugs ... you can manage people fairly effectively before they start having seizures or before they get into too much of a mess. AE8INT,13,622*

As well as planning and prioritising, the nurse felt that time management was crucial to her handling conflicting demands.

*You have to decide what you can best achieve in the time [available] ...you could spend an hour with a patient but that's not fair on the other patients... so you have to switch... So it's about managing your priorities in a manner that is suitable for the patients. AE8INT, 12,569*

## **Surgical Ward Drugs Round**

The exemplar episode lasted 110 minutes, and is depicted in the HTT diagram in Figure 6-29. The three coloured (or greyed-out) rows correspond to the three levels of the HTA diagram presented in Figure 6-4 (page 249). (The HTT diagram adopts the same format as that presented in the previous section – although patients were numbered according to their bed number rather than the order in which they arrived on the ward.)

The episode occurred at 13.02, midway through the nurse's afternoon medication round, which had started late at 12.30pm (the nurse having been delayed by an unplanned task). The round involved the nurse preparing and administering drugs for six patients in a single-sex bay (there were only five beds in the bay, but one additional patient was admitted [P6 on Figure 6-29], after another [P3] had been discharged, making six in total).

At the start of the episode the nurse had completed rounds for P1 and P2 respectively, but had yet to start the round for P3 to P6. The nurse claimed that her morning had been 'normal' in terms of her workload and stress levels although she admitted feeling frustrated at the delay to the drugs round.

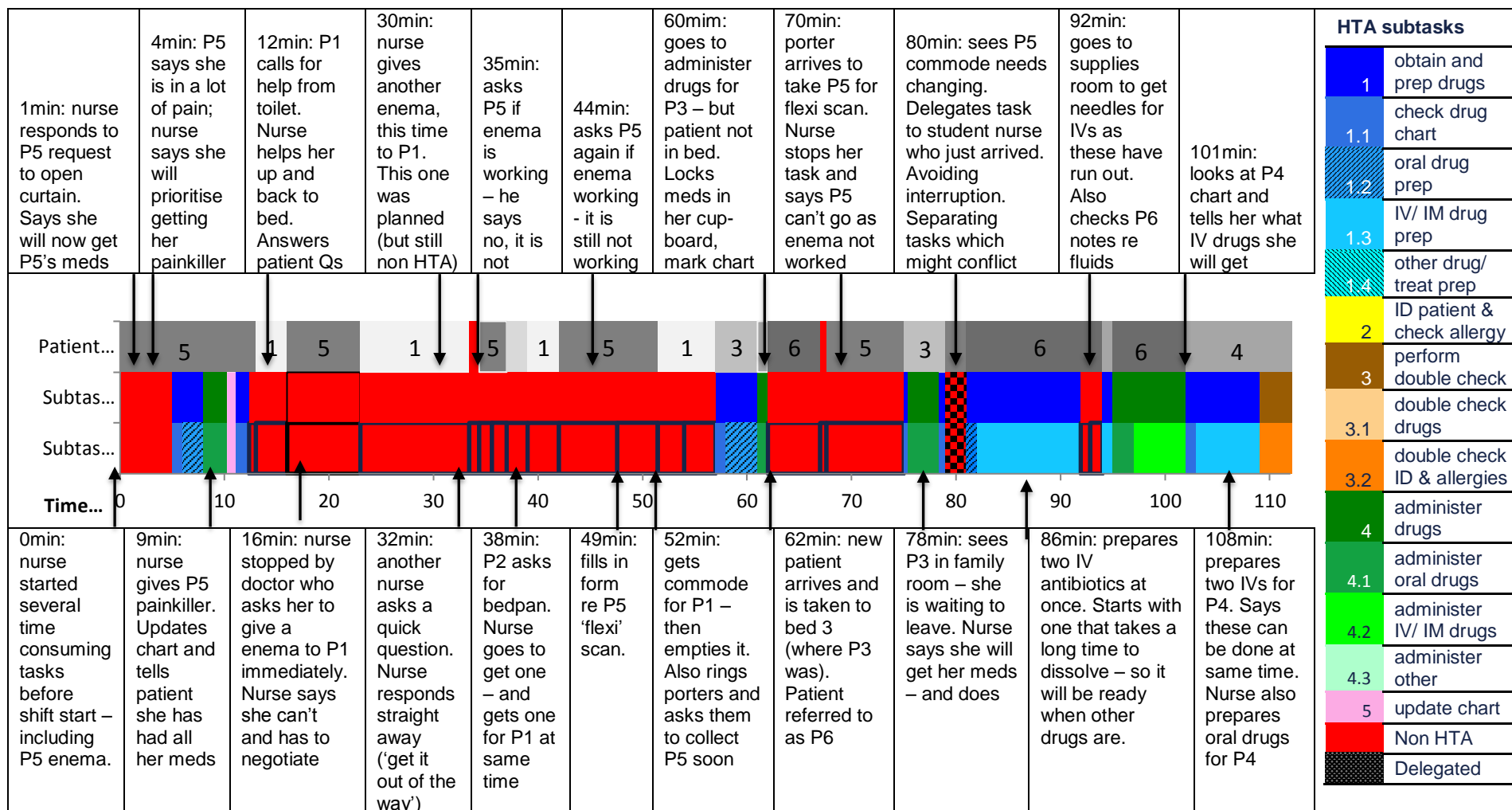


Figure 6-29 Hierarchical Task Timeline Example for Surgical Ward

The main demands faced by the nurse related to the quantity and complexity of patient medications, the need to deal with unplanned tasks – especially those that were unpredictable and urgent – as well as the lack of help from support staff (SU4FN 1; SU4FN 3).

The nurse kept both a mental and a physical ‘to do’ list to keep track of competing demands, and she claimed to have accumulated tasks throughout the episode (SU4FN 3).

The quantity and complexity of patients’ medications varied considerably (SU4FN 3). Some patients required just one or two drugs, with minimal preparation (e.g. P5 had only oral paracetamol), while others were given multiple drugs, with elaborate preparation requirements. For one patient (P6; 86 minutes), the nurse had to prepare two intravenous (IV) antibiotic drugs which involved calculating the appropriate volumes of three different substances, mixing them together using various tools (e.g. fluid bags, vials), and having another nurse check the drugs.<sup>61</sup> This took almost 10 minutes – but it was then necessary to wait for one of the drugs to dissolve (i.e. before the drug could be prepared and administered) – which took another 20 or so minutes. The need to manage temporal IV drug administration requirements also added demands for the nurse (SU4INT, 9,435).

The nurse spent more than half of the episode (around 60 minutes out of 110) dealing with unplanned tasks. The most time-consuming of these involved giving enemas to two patients, P1 and P5 (the enema for P5 given before the round had

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<sup>61</sup> In general, IV drugs were more complex/ difficult to prepare.

to be re-administered; 30 minutes), and performing follow up tasks in relation to these (see 35, 44, 70 minutes). Other frequent or time-consuming unplanned tasks included answering patient questions (12 minutes), dealing with colleague queries (32 minutes), and cleaning commodes and bedpans (e.g. 38, 52 minutes).

The fact that many unplanned tasks were urgent in their timing added demands – including the need to switch between tasks frequently – and made it difficult for the nurse to focus on her drugs rounds (SU4FN 3).

*P5 was prescribed the enema... It needed to be done at twelve o'clock so she was able to go to her flexi (scan). ... But now I have to do an enema for someone else... And then this enema didn't work so I have to ask for another one... And, in between all that, I had to do my [medication] round SU4INT,2,65*

The nurse felt that she should have received help with unplanned tasks from one of the two Health Care Assistants (HCAs) working on the shift. Tasks involving 'toileting' (emptying bedpans, accompanying patients to the toilet), according to the nurse, should have been performed by the HCAs. The reason is that dealing with 'toileting' while also performing the drugs round was considered inefficient i.e. because each time the nurse switched from one of these tasks, to the other, she had to wash her hands, put on (or take off) gloves etc (SU4INT,6,297).

The nurse did not attempt, at the start of the medications round, to plan the round in detail. She did, however, check which patients were having IVs before commencing the round, as this was said to be the most important logistical issue

that required consideration (since IVs were more difficult to prepare, and more time consuming to administer).

*Usually when you do the rounds in the morning, the first round, you would check the [patients' drug charts]...and the IVs on the charts. So you know more or less you've got 2 people or 3 people who need IVs so you know when you are going to do your round at lunchtime and then you have to start with these 2 or 3 people. SU4INT,10,457*

While planning might not have been detailed, it was clear that the nurse had anticipated how certain events might unfold during the episode (SU4FN 2). The nurse prioritised getting a commode for a patient (P5), having anticipated the need for this (38 minutes; SU4INT,5,249).

The nurse was observed monitoring patients and the environment to ensure she was aware of tasks and could respond appropriately (SU4FN 3; SU4INT,16,788).

The nurse emphasised the importance of closely monitoring patients whose conditions were unstable. The physical environment supported her in keeping abreast of potential demands and allowed her to respond to these quickly (SU4INT,16,837).

*Some patients might go down hill very quickly... that patient [p2] could have been one example, she could have gotten in trouble as she was not stable. I had to keep checking how she was SU4INT,5,249*



The nurse used a variety of cognitive and physical tools to support her handling of competing demands (SU4FN 2). Patients' drugs charts provided up-to-date information, helped her to plan her round and keep track of what she had/ had not done (SU4INT,10,481). The nurse used the shift handover document to maintain awareness of unplanned tasks and other demands that might be forgotten.

*So usually I will make a note here [on the handover document] of what I have to do [ad hoc patient tasks] for each of them. [Nurse points to her handover document from her shift].. SU4INT, 14,660*

So concerned was the nurse about the dynamic nature of patient treatments – and the potential for errors that this created – that she insisted that any non-routine tasks be written down by the medical team before she actioned them (SU4INT,15,701).

The nurse demonstrated sensemaking (making sense of contextual information to understand and anticipate a situation) when she checked P6's notes to ensure that the patient's drug chart was correct regarding the prescription of fluids. This ran contrary to the nurse's expectations, hence she felt it important to check (90 minutes).

*Yes, for the last patient [P6]... I was surprised she was on this fluid as she was still just recovering [from a recent operation].... It didn't all add up. So I checked that they [the fluids] were written in the notes. SU4INT, 14,730*

Time management could be seen in a variety of behaviours – prioritising tasks that would save time later in the shift, grouping of tasks (e.g. mentally, or in time/ space) and efficient handling of unplanned tasks and ‘switching events’ (SU4INT, 5,249). In one example, the nurse started preparing an antibiotic drug, ‘Tazacin’ in advance to avoid having to wait around later (e.g. 86 minutes).

*The following bed [P6].... you got a long antibiotic, it takes forever to dissolve....*

*So you give the first one which is already made... [Then] by the time you finish*

*one, the other one [Tazacin] is [ready]. SU4INT,9,441*

### **6.3.3.2 Summary and Comparison**

This section summarises the main themes identified by the thematic analysis of the timeline data, and compares these across the study settings. (An extract of the framework created for the timeline analysis is included in Appendix J.) The themes relate to: 1) the nature of the demands faced by nurses; and 2) nurses’ handling competing demands.

As in Phase One, demands were (again) characterised by the complex and dynamic nature of nurses’ work. The main types of demands in both settings/ tasks related to the volume of patients, and the complexity of patients’ conditions and/ or their treatments. The need to perform unplanned tasks added considerable demands in both settings, however these tasks were generally more complex in the surgical ward. For example, most unplanned tasks in A&E involved triage nurses performing simple tasks to follow up from the triage (e.g. getting a drink or a blanket), while in the surgical ward such tasks were more

varied and they frequently involved resolving challenging problems vis-à-vis obtaining drugs or equipment. Other differences between settings in the sources of demands included that problems with teamworking, and the availability of key resources, added to demands in the surgical ward, while the unequal distribution of requirements added to the workload in A&E.

As in Phase One, nurses in both settings accumulated tasks on a (physical or mental) to do list, while they had to manage these within the constraints of the specific task – and of course, within the constraints of the clinical setting more generally (e.g. including organisational and social factors).

Nurses used a variety of adaptive strategies and behaviours, as well as various aspects of the work system, to handle competing demands – as described in the subsections below. It should be noted that different strategies were frequently used in combination with one another, and were considered interdependent in many cases – hence why they might not appear to be discrete (or mutually exclusive) below. In a similar vein, the strategies were combined with the use of different work system aspects (e.g. tools and technologies were used to support planning; the physical environment supported patient monitoring). The description of relevant work system factors is therefore integrated with the findings regarding adaptive strategies.

### **Strategic time and attention management (including interruptions and multitasking)**

Strategic time and attention management took a variety of forms. Nurses in both settings planned their work and prioritised tasks that might have created

additional work if delayed (SU3INT 10; SU6INT 5; AE3INT 14). Nurses also planned how to handle time consuming tasks, to make sure these were completed within the required timeframes (SU6INT 6; AE8INT 16).

Sometimes prioritising meant interrupting current activities, while at other times it meant deferring unplanned tasks until a current job was completed (AE3INT 18; SU3INT 8; SU6INT 3). Nurses interrupted tasks in order to respond to urgent requests (SU4INT 17; SU6INT 13). Interruptions also allowed nurses to take advantage of limited opportunities to obtain resources (AE1INT 10; AE3INT 2).

Nurses were more likely to interrupt current activities in favour of quick and easy tasks, compared with longer, more demanding jobs (AE6INT 9; SU2INT 4).

Surgical nurses were concerned to preserve (i.e. not to disrupt) drug preparation and administration routines, hence they were less flexible, in general, about interrupting than A&E triage nurses were (SU4INT 6; SU6INT 13).

Sometimes it was possible to handle multiple tasks concurrently, which could be time efficient, but this could only be done in limited circumstances e.g. where tasks were relatively easy, or where safety was less of a concern (SU3INT 4; AE8INT 2). In the context of the surgical medications round however, nurses rarely multitasked patient rounds (SU2INT 1; SU6INT 9).

Nurses planned their time carefully so as not to become 'stuck' on a current task, at the expense of competing demands (SU3INT 6; AE1INT 14), and they set time goals to stay on top of their workloads (SU2INT 11; AE6INT).

A&E triage nurses' time management was often motivated by the need to meet hospital targets regarding the maximum wait time for triages (AE1INT 7; AE8INT 6) whereas surgical nurses were concerned, more generally, to ensure patients were stable and well (SU3INT 3).

### **Monitoring and sensemaking**

Nurses in both settings combined frequent monitoring of events with sensemaking (using contextual information and knowledge to understand and anticipate a situation), in order to keep track of, and to prioritise, competing demands.

Monitoring and sensemaking were important in the context of the A&E triage for several reasons. Monitoring was important because triage nurses usually helped the Charge Nurse, on an informal basis, with ward management duties (AE1INT 2; AE3FN 4). This required a good knowledge of patients who were in the department – which was relatively easy for triage nurses to obtain given that they had assessed many of them (AE8INT 8). Nevertheless, triage nurses took a number of steps to follow patients' progress and keep track of events in the department.

Sensemaking played a crucial role in patient assessments since individual's illnesses were often complex, and nurses were required to integrate data from various sources, to make inferences to support their assessments (AE3FN 2; AE8FN 4).

In the context of the surgical medications round, monitoring and sensemaking were needed because patients often had complex illnesses, and they were frequently unstable. Nurses were responsible for recording data regarding patients' vital signs, and they had to integrate this data, and make sense of it, to keep track of patients' conditions (SU3INT 12).

Another reason why monitoring was important during the drugs round was that nurses were administering very potent medications, in many cases, and they therefore needed to check that these were tolerated by patients (SU3INT 16).

Nurses used the wider team (colleagues) to support sensemaking and monitoring. A&E triage nurses asked colleagues to alert them when a new patient arrived for triage – while they also communicated extensively with colleagues to share information regarding patients' progress (AE8INT 12; AE6FN 2). This allowed them to maintain awareness of patients' status, so they could help with ward management.

Surgical nurses also used colleagues to support monitoring, and they shared information regarding the following: the availability of drugs and equipment, the use of drug protocols, and the accessibility of particular clinicians (SU2FN 1; SU2INT 10). (That surgical nurses did not keep one another updated regarding individual patients reflects the fact that nurses' medication rounds were an individual activity, while the triage was more integral to the functioning of the nursing team in A&E.)

In terms of sensemaking, surgical nurses sometimes asked colleagues to help make sense of patient observations (e.g. vital signs, fluid intake) and/ or details regarding individual's current prescriptions. This was particularly the case in one observation session where the drugs round was performed by a relatively junior nurse (SU3FN 5).

Given the importance of sensemaking in assessing patients, this strategy might have been used more in the A&E triage compared with the surgical drugs round (because the triage nurses were constantly assessing new patients; AE6FN 3). That said, surgical patients were often less stable than those in A&E, and they frequently had more complex conditions, hence surgical nurses continued to assess individuals (albeit on an adhoc basis) throughout their rounds (AE6INT FN4). In addition, surgical nurses frequently made sense of contextual information regarding individual patients (e.g. knowledge of individual's medical histories) to facilitate error checking regarding patient prescriptions (SU6FN 2; SU6INT 10).

A range of tools and artefacts were used to support monitoring and sensemaking. A&E triage nurses made extensive use of the A&E computer system to keep track of patients that they had triaged, to determine which rooms might be free (in order that they could know where to put newly-triaged patients), and to learn about individual patient's conditions (e.g. in the event that they had not triaged the patient themselves; AE1INT 6). Triage nurses also used sorting and colour coding on the computer system to keep track of patient wait times, and they used of the ambulance computer system in order to anticipate any peaks in demands (AE1INT 10).

The main tools used by surgical nurses to facilitate monitoring and sensemaking during medications rounds included patients' drugs charts, medical notes, and adhoc lists. Nurses checked drugs charts before the beginning of the afternoon and evening rounds, to establish whether there had been any changes relative to the previous round. This ensured that newly prescribed drugs were not omitted, and it allowed the nurse to better plan her round (SU6INT 9; SU3FN 3).

Most of the observed nurses used the drugs chart to record both the: i) preparation of drugs, and ii) their administration (SU3INT 7 SU6FN 2). This helped them to keep track of what tasks had already been completed, and hence to quickly identify the appropriate point of the task to resume in the event of an interruption (SU3INT 12; SU3FN 2).

Aspects of the physical environment that supported A&E triage nurses' monitoring and sensemaking included the location of the triage desk vis-à-vis the Charge Nurse area. Being close to the Charge Nurse area was helpful because other clinicians tended to congregate there, and nurses were able to ask questions about outstanding patient tasks (e.g. triage 'follow up' tasks). They were also able to glean a lot from listening to others' conversations (AE8INT 11).

Aspects of the physical environment that supported surgical nurses' monitoring and sensemaking included the fact that patient bays were small and nurses could see, for example, if any individual had an adverse reaction to a drug treatment (AE3INT 4).



Individual factors that supported nurses' sensemaking and monitoring included individual knowledge and experience. This was thought to support sensemaking because it allowed nurses to integrate heterogeneous information and make sense of it in an holistic way (AE1FN 4; AE1INT 12; SU6INT 1). Monitoring was also supported by the ability to anticipate events, which was also thought to be developed through experience (AE3INT 11).

### **Planning and anticipating**

The role of planning and anticipating has been described extensively in the previous sections, hence the current section is relatively short. Planning supported handling competing demands in the surgical drugs round as it allowed nurses to identify, at an early stage, drugs or other resources that might cause delays (AE6INT 5; AE1INT 15). Drugs, and drug giving equipment, were sometimes out of stock and nurses had to take additional steps to obtain them (e.g. going to the supplies room, or another ward to get drugs, or requesting that the pharmacist orders a new batch; AE3INT 4; AE6INT 14). In addition (and as noted in other sections) some drugs imposed considerable temporal and sequential requirements, both in their preparation and their administration. Finally, medical staff were an important 'resource' for the drugs round (i.e. since they prescribed patients' drugs, and had to approve any amendments to their regimens), yet they were available for only for a limited period (AE1INT 7). Nurses claimed that they planned their rounds to handle all of these (competing) demands, to avoid delays or some worse outcome (SU4INT 12; AE6INT 7)

Surgical nurses claimed to have started planning their round during the shift handover, when they were given details of patients' conditions and key

treatments (AE6INT 9; AE3INT 2). They then built on this by reading patients' drugs charts, to anticipate any treatments that might be problematic, and by joining in with the doctors' rounds, to make sure that they were fully informed (AE3INT 18; AE6INT 2). Nurses continued planning their drugs rounds throughout their shifts, although they avoided over-elaborate planning as this was rarely worthwhile (AE3INT 4; AE1INT 9).

Planning was both more difficult, and, arguably, less necessary in the context of the A&E triage (AE6FN 1; AE1FN 3). It was less possible since surgical nurses, unlike triage nurses, had little advance knowledge of the patients that they would have to triage – however A&E was generally better staffed and triage nurses gained more support from their colleagues when required, hence planning was crucial (AE8FN 2). Triage nurses did however engage in planning when helping with ward management activities (which they juggled alongside the triage) – for example they planned to make sure that patients were seen within the 4 hour wait time.

Individual knowledge and experience supported planning and anticipating in a number of ways. In both settings, medical knowledge and experience was considered crucial in facilitating accurate patient assessments, and in anticipating potential complications (AE6INT 4; AE1INT 17). In the context of the surgical drugs round, knowledge of different medications and treatment protocols supported planning since nurses better appreciated the requirements of the (drugs round) task.

## **Grouping tasks strategically**

Nurses grouped tasks together, in various ways, to support efficient and safe task management. This strategy has been discussed extensively in previous sections, hence this section is relatively short.

A&E triage nurses grouped tasks that required them to go to reception, or to the store cupboard (e.g. to get supplies used for obtaining observations during the triage). These were located close to one another – but a long way from the triage desk – hence retrieving multiple items from the store and reception at the same time saved considerable walking (AE6INT 3; AE3INT 12). A&E triage nurses also grouped tasks that required specialist equipment. For example, having established the need to perform ECGs for multiple patients, triage nurses ‘grouped’ these tasks by performing one immediately after another (note that ECGs were a triage ‘follow up task’; AE1INT 3). They explained that it was easier to do this because it was often difficult to find the ECG machine, so nurses wanted to avoid doing this multiple times (AE1INT 3).

As described in previous sections, surgical nurses focused, when doing their drugs rounds, on one patient at a time (SU3INT 4; SU3INT 3), while they grouped drug preparation and drug administration subtasks into separate task phases (SU4INT 11). Nurses considered that grouping tasks allowed them to develop routines, and these, in turn, were thought to increase efficiency and resilience (SU6INT 7; SU2INT 15; AE1INT 14).

Just as nurses grouped similar or interdependent tasks, they also liked to keep separate tasks that did not compliment one another. A good example of this

concerned surgical nurses' separating the drugs round and 'toileting' tasks – however A&E triage nurses also dealt separately with tasks that might compromise hygiene (e.g. cleaning a patient bay) and those that required cleanliness (e.g. taking observations; AE6INT 3).

### **Dynamically adapting performance requirements**

The final strategy involved the dynamic adjustment of performance requirements for specific tasks – and trading off competing clinical goals and tasks. This strategy was used frequently during both the A&E triage and the surgical drugs round. As mentioned earlier, A&E triage nurses were generally concerned to support the meeting of time goals, such as the 15 minute triage wait time, and the four hour maximum wait time. However, when triage nurses were especially busy (e.g. because a number of patients had arrived within a short time period), nurses prioritised safety-critical tasks over those jobs which would allow them to meet targets (AE6FN 4; AE6INT 15; AE3INT 15).

Another form of goal adaptation concerned examples, from both settings, of nurses 'speeding up' at certain times (e.g. when they were very busy). Surgical nurses completed drug preparation faster when competing demands were especially high (SU2INT 7). A&E triage nurse's 'speeded up' patient assessments when the department was extremely busy (AE8INT 11). Nurses explained that working quickly could be safer when there were many competing demands since there was a danger that key tasks could be left undone (AE8INT 11).

Examples of surgical nurses' dynamic goal adaptations included several behaviours that violated protocols and procedures for giving drugs. Examples

included nurses: 1) failing to observe patients consume their drugs (e.g. a nurse left some painkiller drugs next to a patient's bed while he/ she was in the toilet; SU6FN 3), 2) delaying patient rounds (in some cases by more than one hour) because they had urgent or safety-critical tasks to manage, and 3) failing to check patient's identities in the afternoon and evening rounds, having done this in the morning (SU2INT 7; SU6INT 14). As noted in earlier sections, nurses also interrupted the medications round on occasion when another task was considered more safety-critical or urgent (e.g. getting input from a medic during the limited). While all of these behaviours would seem to be unsafe, nurses felt that they were reasonable adaptations that reduced their workload during the drugs round, which supported rather than undermined safety (SU2INT 9).

### **6.3.4 Discussion**

Only a brief summary of the study findings, and their implications, is provided here since the General Discussion is very comprehensive. In addition, there was little need to contextualise the Phase Two results vis-à-vis the rest of the literature, for two main reasons. First, the similarity of the Phase Two findings with those presented in Phase One means that many of the results (e.g. relating to the frequency of interruptions) have already been contextualised. Second, given the use of a new conceptual framework to guide the study, almost all of the findings can be considered novel.

The aim of Phase Two was to examine how nurses used adaptive strategies (including interruptions) as well as the wider healthcare system, to handle competing demands in the context of a discrete nursing task (one in each study

setting). Specific objectives included to describe the nature and type of demands that competed for nurses' attention while they performed the specific task.

As in Phase One, nurses were (again) found to manage tasks in the context of competing demands, which resulted from the interaction of various work demands and healthcare resources. Also like Phase One, demands were (again) characterised by the complex and dynamic nature of nurses' work.

A&E nurses faced fewer competing demands during the triage, on average, than surgical nurses did during the medications round (although competing demands were not quantified). The main types of demands in both settings related to the volume of patients, and the complexity of patients' conditions and/ or their treatments. The need to perform numerous – and varied – unplanned tasks added considerable demands in both settings, although these (unplanned) tasks were generally more complex in the surgical ward. Other sources of demands varied by setting; problems with teamworking, and the availability of key resources, added to nurse's workload in the surgical ward, while the unequal distribution of requirements was an additional source of demands in A&E.

As in Phase One, demands were found to compete with one another when they exceeded the available resources. The resources available to individuals to handle (competing) demands included a range of adaptive strategies – as well as aspects of the healthcare system. Adaptive strategies that were used included strategic time and attention management (including interruptions and multitasking) strategies, sensemaking and monitoring, planning and anticipating, and grouping tasks strategically. Also as per Phase One, nurses used a number

of non strategic – but nevertheless adaptive – ‘opportunistic’ behaviours to deal with competing demands (e.g. taking advantage of chance encounters with individuals, and opportunities to access resources).

Aspects of the healthcare system that supported handling competing demands included features of the work organisation (e.g. teamworking in A&E), tools and technologies (e.g. drugs charts for the surgical drugs round), the physical environment (e.g. the location of monitored cubicles for the A&E triage), and time (e.g. having time to plan). Individual nurse factors relating to knowledge and experience also supported managing competing demands.

The above results supported the integrated model of interruption context, first presented in the Conceptual Framework. They did however, provide greater specificity and detail regarding particular adaptive strategies that were used by nurses relative to the first version of the model. Figure 6-30 presents a revised version of the integrated model with a number of adaptive strategies added (highlighted in blue text). (Note that Phase Two focused more on the higher level strategic behaviours used to handle competing demands than the minutiae of interruption handling – hence little evidence was found vis-à-vis the Three Stage Model, which is also part of the integrated model).

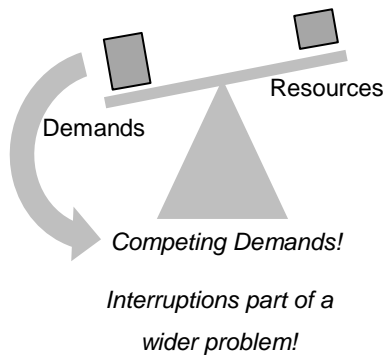
Key limitations of Phase Two are discussed in the General Discussion.

## DEMANDS & TASK FACTORS

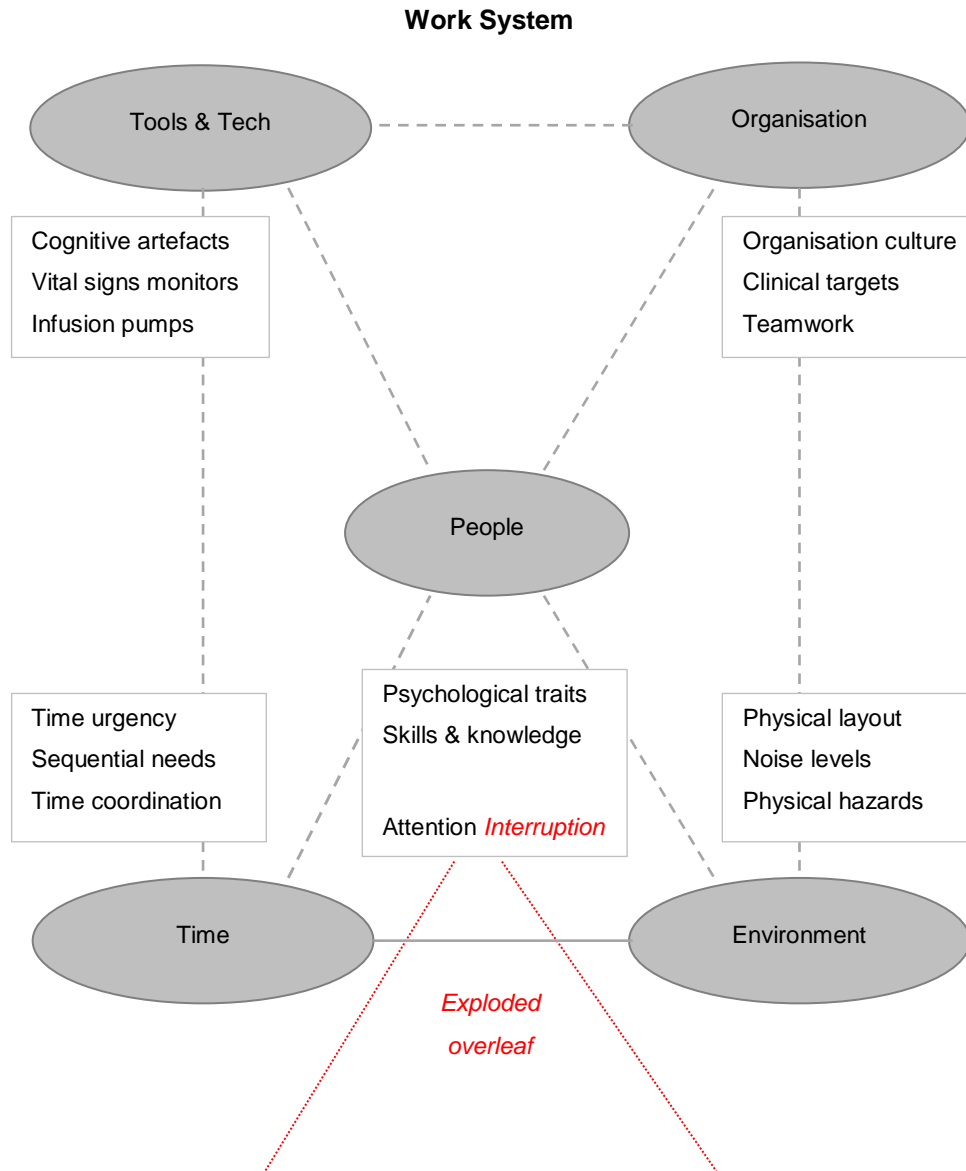
Changing priorities  
Unpredictable events  
Incomplete information  
Time constraints  
Task complexity  
Sequential requirements

Unplanned tasks

*Interruptions*



## RESOURCES



## Processes

### Care processes

Care pathways  
Treatment protocols  
Individual care plans

### Support processes

Cleaning  
Catering  
Maintenance

### Adaptive processes

*Interruptions*  
Multitasking

Strategic time and  
attention management  
Sensemaking and  
monitoring  
Planning & anticipating  
Grouping tasks  
Dynamically adapt goals

Opportunistic behaviours

Adapt

## OUTCOMES

### Patient outcomes

Care quality  
Patient safety  
Satisfaction

### Staff & organisation

Job satisfaction  
Stress & wellbeing  
Health & safety  
Staff Turnover  
Organisation performance  
Profitability/ sustainability

Monitor performance



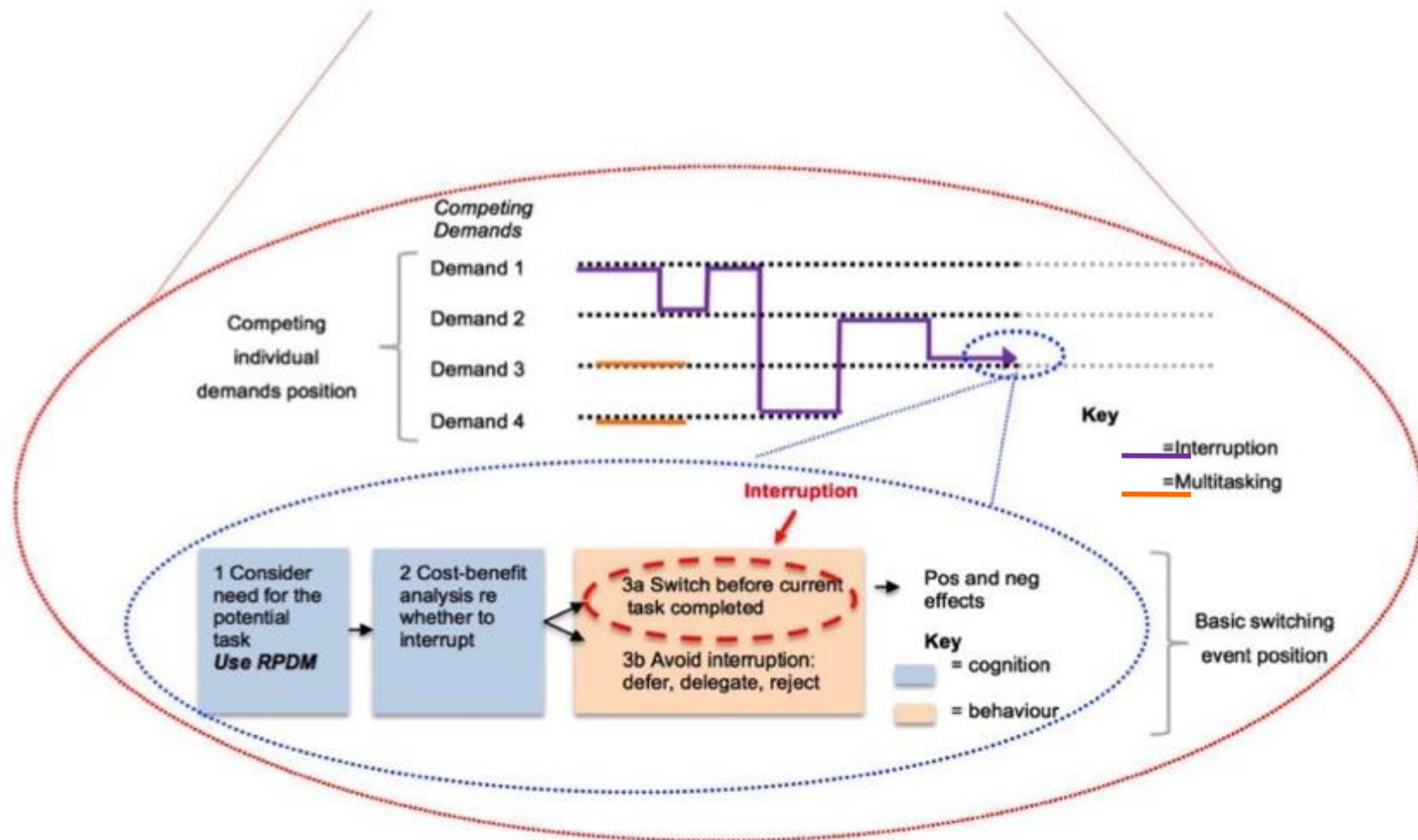


Figure 6-30 Integrated healthcare context model (revised)

## **Chapter 7 General Discussion**

This chapter describes the main contributions of the thesis, and key implications for clinical practise. The limitations of the research are also highlighted, and potential directions are suggested for future studies. A summary of the thesis, including both the Phase One and Two studies, however, is provided first.

### **7.1 SUMMARY OF RESEARCH FINDINGS**

The overall aim of the research was to understand the nature of interruptions occurring in dynamic clinical settings, and to better appreciate the role of clinical context in shaping nurses' handling of these events, alongside their other responsibilities.

Phase One described the context of nurses' work, investigated the nature of nurse interruptions, and explored how nurses handled these events, in three clinical settings. Nurses' work in all three study settings was complex and dynamic – as evidenced, for example, by the need to coordinate multiple resources, to handle unplanned tasks and changing priorities, and to manage temporal constraints. Surgical nurses' work – followed by that of chemotherapy, and A&E nurses – was the most complex and dynamic.

Complexity and dynamism resulted from the interaction of a range of different aspects of the clinical context (e.g. staffing levels, the physical environment, the availability of resources), while these factors also created competing demands

for individual nurses. Nurses accumulated unplanned tasks on a 'to do' list, and these had to be managed in relation to planned activities (i.e. tasks that nurses knew about at the start of their shift), and in the context of clinical, organisational, and social constraints.

The need for, and the nature of, interruptions emerged in relation to competing demands. Interruptions supported the handling of competing demands by facilitating timely responding to unplanned tasks, by enabling nurses to exploit limited opportunities to access resources, and by allowing them to coordinate temporal and sequential task requirements, among other benefits. The majority of interruptions were self-initiated, and only on occasion did they occur in response to an obvious external event.

As well as supporting the handling of competing demands, interruptions also added to these demands. Nurses usually had to resume the original activity (the 'primary' task), and they were required to plan and prioritise tasks, and to conduct cost-benefit analyses regarding how particular jobs should be managed.

Nurses were sensitive to the context in handling unplanned tasks, and they managed these tasks appropriately in relation to competing demands. More experienced nurses were superior at identifying the need for unplanned tasks, and they were usually more effective at handling these.

Speaking more generally about nurses' handling of competing demands (i.e. and not just about their handling of unplanned tasks or interruptions), the study suggested that nurses merged both strategic and opportunistic behaviours to adapt to these demands.

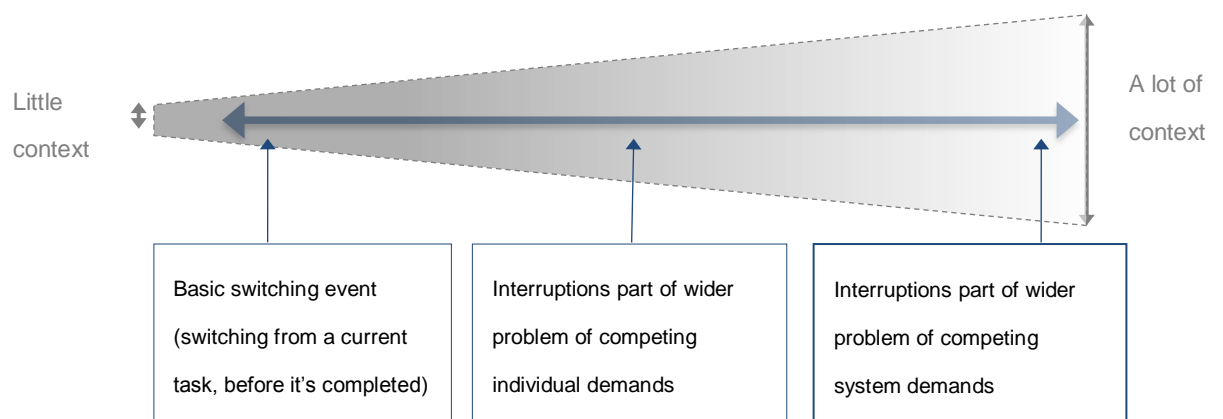
Phase One highlighted considerable shortcomings regarding the ability of extant accounts of interruption – including the traditional account identified in the Literature Review – to explain nurses' task switching and task management behaviour.<sup>62</sup> Because of this – and to meet one of the main study objectives – efforts were made to develop a new conceptual framework. A narrative review was conducted of studies that might support further interpretation of the Phase One results, and provide insights vis-à-vis interruptions and competing demands. The findings of this review (together with the Phase One findings) were then used to develop the conceptual framework.

The framework comprises two models – a model of interruption handling, and a model of the role of the healthcare context in shaping interruptions. The (Three Stage) model of interruption handling suggests that managing unplanned tasks involves thinking critically about the need for unplanned tasks, prioritising activities and situational constraints, and conducting cost-benefit analyses, to support task management. All of these are thought to draw heavily on individual experience.

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<sup>62</sup> The traditional account suggests that interruptions involve the suspension of a current task in order to attend to an externally imposed unplanned task or event. It is further assumed, in most cases, that the original task must be resumed at a later point.

The integrated model of healthcare context (of interruptions) illuminates the role played by the clinical context in producing – and in managing – competing demands. The model describes how interruptions can be understood at three different points along a ‘healthcare context continuum’ (as depicted in Figure 7-1). On the left side of the continuum, interruptions are described as a ‘basic switching event’ (an event where a clinician switches from a current task, before it is completed, to an additional task). The further one moves to the right, the more context is provided. The middle and far right positions view interruptions in terms of a wider challenge of competing demands. (Demands are thought to compete with one another when they exceed the available resources.) While the middle position describes competing demands vis-à-vis individuals’ work, the right position pertains to competing demands at the healthcare system level.



*Figure 7-1 Healthcare context continuum (of interruptions and competing demands)*

Phase Two was guided by the conceptual framework. The aim was to develop a deeper understanding of how nurses used specific adaptive strategies – including interruptions – as well as the wider healthcare system, to handle competing demands, in the context of two discrete nursing tasks (the ambulance triage in A&E, and the medications round in the surgical ward).

Phase Two identified a range of strategies that were combined by clinicians to handle competing demands. These included strategic time and attention management (including interruptions and multitasking), sensemaking and monitoring, planning and anticipating, grouping tasks strategically, and dynamic adaptation of performance requirements. Key aspects of the work system used by nurses to support managing competing demands included a range of tools and technologies, and work processes (e.g. teamworking). These findings were used to refine (or add specificity to) the integrated model of interruption context.

## **7.2 CONTRIBUTION**

The thesis makes important contributions to knowledge regarding interruptions, strategic task management, and healthcare complexity in general. Five key contributions are highlighted in the sections below.

### **7.2.1 Contribution 1: a new conceptual framework of the healthcare context of interruption**

First, by highlighting the lack of a clear, shared conceptual framework – and by identifying limitations of the traditional account of interruptions (e.g. in its ability to account for the complexity of nurses' task management in dynamic healthcare settings), this research identified the need for a new conceptual framework of interruption. Key limitations of the traditional account include that health professionals usually manage tasks in the context of multiple wider responsibilities (and not just vis-à-vis a primary and secondary task), and that it appears to conflate several distinct events.

The thesis provides a new conceptual account of interruption, based on empirical evidence, that addresses key limitations of the traditional account vis-à-vis dynamic healthcare work. Five main benefits of the new account (the integrated model of interruption context) include that it: 1) illuminates the aetiology and complexity of interruptions; 2) highlights that interruptions have both costs *and* benefits – often simultaneously; 3) recognises that interruptions represent a time management strategy for handling competing demands; 4) highlights the wider problem space that surrounds interruptions; and 5) emphasises the context in which unplanned tasks are handled. Further explanation regarding each of these benefits is included in the subsections below.

#### ***7.2.1.1 Illuminates the aetiology and complexity of interruptions***

The integrated model recognises that the need for, and the nature of, interruptions emerges from the context – and from interactions among various aspects of the healthcare system – thereby illuminating the aetiology and complexity of these events. Better understanding the aetiology of interruptions could be important because it provides direction regarding how these events – and perhaps, any deleterious effects that they might have – might be reduced. Better appreciating the complexity of interruptions may be helpful because it might encourage researchers to adopt more sophisticated approaches to studying these events – and to developing interventions to better manage them.

#### ***7.2.1.2 Describes both benefits and costs of interruptions***

The benefits of interruptions are better illuminated by the new conceptual framework, when compared to extant models, for two main reasons. First, defining interruptions in terms of ‘the act of switching’ (switching from a primary

task, before it is completed, to a secondary task), as the current study does, emphasises their role in facilitating adaptation e.g. to the complexity and dynamism of clinical work. This is well illustrated by considering how difficult it would be to work in an environment where one was unable to switch from a current task (i.e. before it was finished) – however empirical evidence described in Phase One also demonstrates how interruptions can support adaptation. Second, many of these benefits (from Phase One) related to the outstanding tasks that nurses had on their ‘to do’ lists (that is, the competing demands) – hence by highlighting the importance of competing demands, the conceptual framework provides a more positive framing of interruption than that afforded by extant accounts. (The latter usually imply that interruptions are negative since they tend to emphasise the difficulty of resuming a task.)

Regarding both costs and benefits of interruptions, Phase One indicated that these often occur *simultaneously*, and the extent to which interruptions were considered positive or negative, overall (i.e. in net terms), depended on which task, or which aspect of the work system, one focused on (e.g. the cost was often for the interrupted task, or the interrupted individual – while the benefits were usually for the interrupter, or for one of the non-current tasks on nurses’ ‘to do list’). The concept of ‘competing demands’, which is central to the new framework, can incorporate this ‘multiplicity’ of costs and benefits i.e. by recognising that interruptions both add to, and support the handling of, competing demands. While a small number of researchers (e.g. Rivera-Rodriguez and Karsh, 2010; Rivera, 2014) have considered that there may be multiple dimensions of – and multiple perspectives regarding – interruptions, this study is the first to link this to an overarching, organising concept (i.e. competing demands).



### ***7.2.1.3 Recognises that interruptions represent a time management strategy***

The notion that interruptions (like multitasking) was defined in relation to time management was important since this distinguishes them from other adaptive strategies highlighted as potentially important in handling competing demands (e.g. planning and anticipating). Many of the adaptive strategies identified in the study might have contributed to time management, but only interruptions and multitasking were *defined* by their supporting this.

### ***7.2.1.4 Illuminates the wider problem space surrounding interruptions***

By framing interruptions in terms of a wider problem of competing demands, and by describing a number of concepts that are related to handling such demands (e.g. unplanned tasks, multitasking), the conceptual framework helps to illuminate the wider ‘problem space’ of interruption. It is hoped that the framework will encourage researchers to examine a wider range of phenomena relating to interruptions than they have done up to now – and to adopt more holistic research approaches capable of providing a deeper understanding.

### ***7.2.1.5 Describes the context in which unplanned tasks must be handled***

A final benefit of the new conceptual framework concerns its describing the context in which unplanned tasks must be dealt with i.e. competing demands. Competing demands were thought to be comprised of several distinct elements – including a mental ‘to do’ list (containing both planned and unplanned tasks) and knowledge of various clinical, organisational, and social constraints, that

compete for prominence. The only 'context' provided by extant accounts of interruption relates to an individuals' performance a primary task, and this can lead to the conclusion that handling these events concerns only the remembering/ resuming of the original activity. However, the need to manage the different elements of competing demands meant that a much wider range of cognitive and behavioural activities were required to effectively deal with unplanned tasks.

### **7.2.2 Contribution 2: study identified benefits of interruptions not previously appreciated**

The second contribution was alluded to in describing the first; the current study identified an array of benefits of interruptions, that are mostly new to the literature. These included: reducing memory demands; enabling nurses to remain productive when faced with a delay; facilitating nurses' exploiting limited opportunities to obtain a resource; supporting coordination of temporal and sequential task requirements; and by facilitating monitoring of patients and events.

On a related note, the study also showed how the concept of interruption, as defined in the majority of studies, has led to the systematic neglect of these benefits (i.e. because many of the benefits of interruptions relate to the wider competing demands, that are not represented by such accounts).

### **7.2.3 Contribution 3: study demonstrated a wider range of cognitive processes involved in handling interruptions**

The study demonstrated that a wide variety of cognitive processes are involved in handling interruptions – and highlighted the role of several specific processes. As per the literature review, previous studies have highlighted the role of memory primarily – but several studies have also shown that planning and prioritising are implicated (Ebright et al., 2003, Potter et al., 2005). Phase one suggested the importance of planning, prioritising, anticipating, judging the need for a task, conducting cost-benefit analysis, experience-based decision making. Phase Two underlined the importance of these – and also highlighted the role of sensemaking and monitoring, and adapting performance requirements strategically.

### **7.2.4 Contribution 4: study highlights the central importance of experience in handling interruptions**

The study highlights, more clearly than any previous healthcare interruptions study, the central importance of nurse experience in handling interruptions, and competing demands. Experience was found to be useful across a range of different aspects of the above phenomena – including ‘identifying’ necessary unplanned tasks, and considering how to handle tasks effectively.

The notion that experience might play a key role identifying unplanned tasks is new to the healthcare interruptions literature, and it challenges existing accounts (of interruption), which suggest this process involves little more than recognising an ‘objective stimulus’ (e.g. an alert for interruption).

The research also highlighted reasons why experienced nurses might be better able to handle unplanned tasks and interruptions compared with their junior colleagues. These included automaticity (where practise allows tasks to be performed using fewer resources), associative activation (where practise strengthens the links between subtasks in memory, making it easier to recall the next action after interruption), and recognition primed decision making (where individuals recognise common task scenarios, and use their memory of how these were handled previously to facilitate decision making; Klein, 1993).

### **7.2.5 Contribution 5: study adds to the literature regarding healthcare complexity and adaptation**

Because interruptions have been framed as an adaptive strategy (for managing competing demands and complexity in general), it follows that the study contributes to the literature regarding healthcare complexity and adaptation. Two specific ways in which this research adds to the literature in this area include: 1) the suggestion that interruptions must be combined with other adaptive behaviours to enable effective handling of competing demands; and 2) the highlighting of two particular models to illuminate healthcare complexity and adaptation.

While interruptions helped nurses in a number of ways, they could not, on their own, facilitate effective task management. For this reason, nurses married interruptions with other adaptive behaviours to achieve clinical goals. Some of these other (adaptive) behaviours were strategic in nature, while others were opportunistic. Strategic behaviours included planning, anticipating, and strategically changing performance requirements, while opportunistic behaviours

included using cues in the environment to support cognition (especially memory), taking advantage of 'chance encounters' with clinicians, and exploiting limited opportunities to perform tasks.

It made sense to combine strategic and opportunistic behaviours in handling competing demands because relying too much on one approach over the other would have proved inefficient. Relying solely on strategic behaviour would have been very mentally demanding (e.g. because such behaviour required considerable forethought), and because it was not always effective given the dynamic nature of clinical work (e.g. a nurse's plans might quickly become redundant after an unexpected turn of events). Relying only on opportunistic behaviour would likely have led to chaotic working, since the clinical environment afforded only limited 'opportunities' to support task management.

The two models that helped to illuminate complexity and adaptation were the SEIPS model (Carayon, 2006) and the Macrocognition Framework (Klein et al., 2003; Schraagen et al., 2008). SEIPS provided a useful structure for examining the healthcare system, and the interacting role of the different system components. Some of the additions included in the revised SEIPS model (SEIPS 2.0; Holden et al., 2011), such as the 'adaptation feedback loop' also helped to illuminate the handling of complexity. One suggestion that might be considered for future versions of the model concerns the potential addition of time as an important aspect of the work system. While time proved to be particularly pertinent in the current study (i.e. since interruptions were distinguished, as a strategy for handling competing demands, by their relationship with time), it might have relevance more generally for those interested in healthcare systems. The importance of time has been overlooked in organisational research, resulting

in incomplete and misleading accounts of phenomena (Roe et al., 2009; George and Jones, 2000).

The value of macrocognition (Klein et al., 2003; Schraagen et al., 2008) was demonstrated by the finding that nurses combined a range of high level cognitive processes – including several specific strategies included in the Macrocognition Framework (e.g. planning, sensemaking) – in managing competing demands in Phase Two. The framework might be improved by adding time management strategies such as interruptions and multitasking.

## **7.3 STRENGTHS OF THE STUDY**

Four key strengths of the research are described in the sections that follow.

### **7.3.1 Strength 1: contextualised research approach**

The current study is among a small number of studies to adopt a contextualised approach to studying interruptions. (Others include the ‘complexity studies’ examined in the Literature Review). The use of both qualitative and quantitative methodologies enabled the collection of rich but detailed data, that provided substantial new insights regarding the importance of the clinical context in shaping the nature and handling of interruptions, among other things. The systematic study of the role of various work demands and key resources (e.g. staff, tools and technologies) illuminated the complexity of interruptions more clearly than previous studies have done. The tendency in existing studies to neglect the wider context, and to adopt deductive, quantitative research approaches, has led to a partial view of interruptions. This view neglects, for

example, the significant role that interruptions can play in facilitating adaptation to aspects of complexity and dynamism.

### **7.3.2 Strength 2: studying cognitive aspects of interruption handling**

That the study highlighted various aspects of cognition that supported handling competing demands demonstrates the benefits of studying clinicians' reasoning and thinking processes. It also implies that specific approaches used in the study, that have not been used elsewhere (or not much), contributed to this. These included the cognitive interview techniques, and the timeline analysis approaches, developed in Phase Two.

The cognitive interview techniques were adapted from established cognitive interview methods, including the Critical Decision Method (CDM; Klein et al., 1989; Crandall et al., 2006, chapter 5), and the Critical Incident Technique (CIT; Flanagan, 1954). The most significant adaptation concerned the researcher's focusing on a recent 'critical' event, which he himself had recorded during observations. (The CDM and CIT methods traditionally involve participants thinking of an historic incident that they considered 'critical'.) The advantages of this were that the richness and detail of the critical incident could be obtained, while some of the problems associated with historic and unverifiable accounts of events could be minimised (Ericsson and Simon, 1993; Patrick and James, 2004).

The timeline analysis techniques were developed especially for the current study – although they were similar in some respects to other time line diagrams (e.g.

see Kirwan and Ainsworth, 1992, p136). The timelines provided a structure within which to integrate rich mixed methods data regarding nurses' handling of tasks, and, combined with the use of established cognitive analysis techniques, this allowed contextualised and insightful analysis of nurses' thinking processes.

### **7.3.3 Strength 3: focusing on clinicians' handling of discrete and specific tasks**

A third strength concerns the advantages that were accrued from the Phase Two study's examination of discrete and specific tasks (i.e. the ambulance triage in A&E, and the medications round in the surgical ward). Two specific aspects of the Phase Two data collection – the use of Hierarchical Task Analysis (HTA), and the iLogger smartphone application – were crucial in terms of the quality and quantity of data that were recorded regarding nurses' handling of the said tasks.

The use of HTA, in advance of the study, allowed the development of a detailed description of the specific nursing tasks – which in turn facilitated more granular and precise analysis of nurses' handling of competing demands (including interruptions). The HTA also provided the basis for the real-time recording of quantitative data regarding, for example, the type and duration of tasks, using the iLogger application. iLogger also allowed, however, the recording of detailed qualitative data regarding the context of nurses' work, and their task management behaviour (to supplement the quantitative data).

Only a small number of studies have conducted very detailed analysis of specific tasks in the manner described (e.g. see the eye tracking and video method studies examined in the Literature Review) – and none have used HTA to



achieve this. The iLogger application, furthermore, has not been used in interruptions research – nor indeed has any other smartphone software that allows the real-time recording of detailed mixed methods data.

#### **7.3.4 Strength 4: innovative analysis approaches**

Other analysis techniques developed in the current study also contribute to understanding of methodology – not only for the study of interruptions, but for studying healthcare complexity, and the nature of clinical work, more generally. Particular analysis approaches highlighted included the task switching analysis, and Multitasking Patient Index.

The task switching analysis drew on workflow analysis techniques described by Zheng and colleagues (2010; 2011). However, while originally intended as a ‘stand alone’ quantitative (workflow) analysis method, the approach was integrated with other qualitative and quantitative data in Phase Two, to provide a deeper, more contextualised understanding.

The Multitasking Patient Index was developed especially for the current study, and it enabled the researcher to quantify the degree to which nurses ‘multitasked’ or ‘serially interrupted’ activities. The measure also allowed analysis of nurses’ adaptive behaviours.

### **7.4 IMPLICATIONS FOR CLINICAL PRACTICE**

Key implications of the research for clinical practise relate to: nurse recruitment and training, and healthcare management in general.

### **7.4.1 Implications for nurse recruitment and training**

The finding that nurses faced competing demands for much of their shifts, suggests the need to recruit, and possibly to train, individuals so they are well equipped, to deal with these. This might help to improve the quality and safety of care, as well as nurse well being and retention rates (i.e. since nurses who are better suited to their jobs may be less likely to suffer ill health, or to leave their jobs).

Regarding recruitment, the research highlights a number of factors that might distinguish individuals who are well suited to handling competing demands from those who are not. Experience and expertise were perhaps the most significant such factors, suggesting that these should – as they currently are in most cases – be weighted heavily in recruitment and selection decisions. As noted in the Concept Development chapter however, and for the reasons described, experience and expertise should not be equated (i.e. not all experienced nurses are experts), and there may be a good case for ‘testing’ specific competencies.

Other potentially important individual factors, which are not generally considered in recruitment and selection decisions, might, now, be looked at. These include cognitive abilities relating to memory, executive functions, and individual adaptive strategies (Phase Two showed that not all nurses used the same strategies, hence these might be regarded as individual factors). Additional research regarding the ability of these factors to predict task management ability, and job performance more generally, should be conducted before these are used to support selection decisions.

Training might seek to develop the same aspects of cognition used to support recruitment and selection (i.e. memory, executive functions, and individual adaptive strategies). Regarding memory, nurses could be allowed practise performing common tasks in simulated settings, since the notion of associative activation, discussed in the Concept Development chapter, indicates that practise strengthens the associative links between subtasks – which might facilitate task resumption after interruption. In terms of interruptions specifically, research suggests that practise in handling such tasks will be beneficial only if individuals are given the opportunity to switch between specific (primary and secondary) task-pairs – hence this should be taken into consideration by those designing the training.

Nurses' memory (e.g. for resuming interrupted tasks) might also be enhanced by teaching nurses some of the strategies identified in the current study, and elsewhere, for handling interruptions and competing demands e.g. deferring, delegating, making reminders, finishing subtasks.

Studies of executive functions suggest that abilities such as response inhibition and mental updating can be enhanced by training (Persson and Reuter-Lorenz, 2008; Lovden et al., 2010; Buitenweg et al., 2012). However, these studies tend to focus on individuals' performance of simple tasks, in artificial settings, and it is not clear whether the benefits of training might transfer to more complex work settings, like those examined in the current study (Persson and Reuter-Lorenz, 2008; Lovden et al., 2010; Buitenweg et al., 2012).

Regarding adaptive strategies, it is not clear whether these could be trained, although the finding that many such strategies involved a behavioural (as well as a cognitive) element, suggests they could be developed to some extent. (Note however that individuals' ability to utilise adaptive strategies might depend on their executive functions; Schraagen et al., 2008).

Another issue that might be covered by nurse training concerns human factors models of healthcare systems. Models such as SEIPS could provide nurses with a good understanding of the nature and complexity of clinical work, while they also provide an opportunity to cover other aspects of healthcare complexity, such as those examined in the current study. Although nurses are taught extensively about the nature of healthcare, they do not usually, to our knowledge, cover systems models that provide a macroergonomic view.

A final suggestion relates to training nurses to be sensitive in interrupting other clinicians – including those from other professional backgrounds. Regarding the latter, one approach that might increase nurses' sensitivity would be to include, as part of nurses' training, first hand experience of – other clinicians' jobs. Better understanding of these might provide an improved basis for nurses to judge when they should, or should not, interrupt.

#### **7.4.2 Implications for healthcare management**

Five key implications of the current research for healthcare management are as follows. First, the finding that interruptions have many benefits (e.g. in supporting the handling of competing demands) suggests the need for healthcare managers to be cautious about developing interventions to reduce the frequency of these

events – or to develop protocols that forbid interruptions during certain activities. The current study suggested that nurses were very concerned by the need to work in a safe and efficient manner, and they traded off competing demands to make appropriate decisions given the specifics of the context. Given the complexity and heterogeneity of clinical work, management should think carefully about proscribing behaviours such as interruption since these might play a crucial role facilitating adaptation.

Second, those who remain determined to develop interventions to reduce interruptions should commit to conducting systems analysis of the factors that contribute to interruptions. The current research suggested that only such an approach – which takes into account an array of potential demands and resources available to in – would be capable of illuminating the interacting factors that produce individual interruptions.

Third, given that interruptions emerged in relation to competing demands, and since the latter arose only when demands exceeded resources, the rate or frequency of interruptions experienced by clinicians might serve as a useful measure of workload (both for the individual and for the work-system as a whole). Management could think about tracking interruption rates over time, and consider what any observed changes might mean in terms the demands placed on individuals, and the wider system to which they contribute.

Fourth, the findings of this, and other studies of interruptions and competing demands, could be shared with healthcare managers, in order that they might reflect upon their contribution to these phenomena. Given that nurses were found to spend considerable time completing administrative work – said to be

prescribed by management – and surprisingly little time with patients, it might be that healthcare managers do not fully appreciate the implications of the administrative requests that they make vis-à-vis frontline care activities.

Fifth, management might consider ways to make patients aware of the complexities and workload challenges that nurses face. This might encourage them to be more considerate about how and when to interrupt.

## **7.5 CONCLUSIONS**

The study has six main conclusions. First, the need for, and the nature of, interruptions emerged through the interaction of multiple aspects of the healthcare system – including specific patient and work demands, and specific features of the healthcare system (e.g. staffing levels, the availability of tools, technologies and resources, clinical protocols and processes).

Second, interruptions can be considered part of a wider problem of competing demands, which are faced both by individual clinicians, and the wider healthcare system of which said individuals form a part.

Third, interruptions supported the handling of competing demands by allowing nurses to adapt to dynamic events and changing priorities. Interruptions therefore have significant benefits for clinicians.

Fourth, experience played a crucial role in nurses' handling of unplanned tasks and competing demands.

Fifth, a wider range of cognitive processes (including planning, prioritising, cost-benefit analysis, and sensemaking) were implicated in handling interruptions and competing demands than extant studies have shown.

Sixth, the study suggests the value of richer, more contextualised research approaches than have been employed in the literature up to now.

## **7.6 LIMITATIONS**

A number of important limitations of the study can be highlighted. These related to the reliance upon shadowing observations, specific issues regarding the measurement and recording of events, the limitations of the quantitative and qualitative analysis respectively, partial analysis of the healthcare system, and specific points regarding the representativeness of the study findings.

### **7.6.1 Reliance upon shadowing observations**

That the study relied heavily on observations, especially shadowing observations, is problematic for two main reasons. First, the research highlighted that many aspects of handling competing demands involved extensive use of subjective, internal (i.e. cognitive) processes, yet only a proportion of the data collected were obtained directly from nurses themselves. It was not always possible, in either of the study phases, to clarify with nurses what they were thinking about – or to establish for certain what they were attending to – during observations, hence inferences were made by the researcher. While a number of steps were taken to try to improve the quality of the inferences that were made (see section on ‘Analytic Rigour’ in the Research Design and General Method

Chapter, page 104), the need to make inferences based on observation data remains a limitation.

The second main reason why relying upon shadowing was problematic concerns the possibility that the researcher's presence effected the results. While no specific evidence of this was found, it is impossible to rule out that nurses might have behaved differently had another, less invasive, method been used.

### **7.6.2 Measurement and recording of events**

In both of the study phases, the researcher used a smartphone to make qualitative notes, or to code aspects of nurses' behaviour quantitatively (in Phase Two). This enabled the recording of rich and detailed data, although the need to do this in 'real time', coupled with the complexity of nurses' work, required that a number of steps be taken to simplify data collection.

Key 'simplifications' for the Phase Two data collection included the researcher using 'shorthand' rather than full words to describe events, the decision to focus on relatively simple and discrete nursing tasks, the 'paring back' of the HTA, and the assumption that nurses could multitask in only one aspect of their work.

The use of shorthand resulted in ambiguous data on a small number of occasions, and this might have 'masked' important insights.

That the Phase Two study focused on a simple and discrete nursing task – which had been 'pared back' to enable faster recording on the smartphone application (see Phase Two Pilot Study, section 6.2.3.2) – suggests that the complexity



revealed through their analysis might, if anything, have underplayed the true challenges involved in handling competing nursing tasks. That said, the particular tasks examined were less discrete than expected, since nurses continued to perform wider ‘ward management’, or general care duties, and the complexity brought about by this was captured by the data collection.

The assumption made regarding nurses’ multitasking, in Phase Two, was that this behaviour could take place only at the ‘patient level’ of the HTA (see Figure 6-3, page 246). The implication of this was that, while the analysis could capture nurses’ managing *patients* concurrently, they could not capture more granular aspects of multitasking, such as nurses’ simultaneous handling of specific subtasks. The reason for making this assumption related primarily to the constraints of the data collection – and specifically, the researcher’s limitations in recording multiple concurrent events in real time, in a reliable manner. While this assumption was reasonable in the context of the current study, important insights vis-à-vis handling competing demands might have been missed as a result.

The above ‘simplifications’, together with other steps described in the Phase Two Method (see Pilot Study, section 6.2.3.2), facilitated the reliable recording of nursing tasks in Phase Two (although rater reliability was not calculated given that the researcher, alone, conducted the fieldwork). Nevertheless, there remained two scenarios in which data could not be perfectly standardised: where tasks were performed extremely quickly, and where nurses multitasked (handled patients concurrently).

In the context of extremely quick tasks, the researcher found it difficult to ‘keep up’ with nurses, and he had to take steps to deal with this. Such steps included

making only brief notes, or, on a small number of occasions, an active choice was made to disregard very quick tasks. As a consequence, it is likely that shorter tasks might have been captured less reliably, and less accurately.

Difficulties with standardising the recording of nurses' multitasking included that the duration of observation sessions varied, meaning that nurses had more opportunity to 'accumulate' multiple patients in some periods than in others (see the Phase Two results, page 268, for full details of the difficulties in standardising multitasking recordings). While many quantitative researchers might object to such 'imperfect' data collection, it was considered in the context of Phase Two including this would be better than having no quantitative data at all. Even if not perfectly accurate, quantitative data can provide information regarding the relative frequency and duration of events, for example, that would provide a more complete view (compared with relying solely on qualitative data). To suggest that quantitative data should be collected only in circumstances where it can be perfectly standardised – as many researchers imply – would be to miss an opportunity to gain additional insight into complex phenomena such as competing demands. Such a suggestion would also hinder the development of useful (and ideally standardised) quantitative measures and tools that could illuminate aspects of complexity in the future (i.e. since some trial and error may be required to support such development).

Another limitation regarding the measurement and recording of events in Phase Two concerned how unplanned tasks were recorded. For the purposes of the study, all tasks other than HTA tasks were described as 'unplanned' – however this proved a rather imprecise way of identifying unplanned tasks. In the surgical ward, most non HTA tasks that the nurse handled during the drugs round could

be regarded as unplanned, in the sense that the nurse had no knowledge of them before the beginning of her shift (see definition of unplanned task in the Conceptual Framework). Using this definition however, all of A&E nurses' work could be regarded as unplanned, at some level.

### **7.6.3 Limitations of the quantitative analysis**

Given the very small sample size, as well as concern regarding the lack of standardisation of some measures (in Phase Two), only limited quantitative analysis could be conducted in Phase Two. Only a small number of statistics were computed, and the (Phase Two) analysis relied more on graphical representation than on statistical testing.

### **7.6.4 Limitations of the qualitative analysis**

It is important to be clear about the limitations of the qualitative analysis in both of the study phases. Many assertions were made regarding nurses' thinking processes and strategies, but is impossible to know for sure that these were, in fact, used by nurses. While a number of the adaptive strategies involved a visible activity or behaviour (e.g. planning often involved using tools such as the computer system), and could therefore be easily identified, some had no physical manifestation and were more difficult to spot.

### **7.6.5 Partial analysis of the healthcare system**

Clear limitations can be highlighted regarding the 'systems analyses' conducted in Phase Two. While the researcher examined a number of specific aspects of the healthcare system that were thought to be important (e.g. in shaping the

nature and handling of competing demands), the attention given to some aspects was much greater than for others. For example, relatively little attention was given to the role of the external environment (macro-level economic, political or societal factors that affect healthcare), despite its likely importance in shaping nurses' behaviour (see Holden et al., 2013). Also, while multiple different types of clinician were thought to play a crucial role in the work system, the study focused only on nurses' roles.

### **7.6.6 Typicality and representativeness**

A number of concerns could be raised regarding typicality and representativeness. Both of the study phases involved small samples and in the case of Phase Two, nurses were observed performing just one discrete task in each setting. Given the latter point, some researchers might question the use of the Phase Two study findings to refine the integrated healthcare context model, first described in the Concept Development Chapter. Two responses can be given to this. First, and as described in the Research Design and General Method Chapter, the methodology for both study phases was designed to facilitate 'generalisation to theory', and not to enable the application of the findings to other settings *per se*. Second, the fact that many of the key adaptive behaviours – and nurses' clever use of the work system – were observed in multiple study settings provides confidence in the results (although the study settings were not completely independent of one another).

## **7.7 FUTURE DIRECTIONS FOR INTERRUPTIONS**

### **RESEARCH**

Future research should build on some of the key theoretical and conceptual contributions of the study. These include basing the research on a clear and coherent conceptual framework; recognising the importance of the context – including the work system – in shaping the nature and handling of interruptions; acknowledging the multiplicity of costs and benefits of interruptions; considering interruptions in the context of other strategic and adaptive behaviours vis-à-vis competing demands; and examining the role of cognition in handling competing demands.

#### **7.7.1 Using a clear and coherent conceptual framework**

Having a clear and coherent conceptual framework is important, for several reasons. These include the need for clear definitions of phenomena (including interruptions), as well as the need to understand the wider ‘problem space’ (of interruption). The study showed that imprecise definitions (e.g. definitions that conflate several different events) can result in misattributions or misunderstandings, while failing to understand the wider ‘problem space’ makes it difficult to meaningfully interpret study results (e.g. extant studies suggest that interruptions occur frequently, but it is difficult to know what to make of this; should interruptions be eliminated, or reduced, or might they be helpful in some respects?). Based on empirical data, the study generated a set of clear definitions (e.g. of interruptions, multitasking), as well as an overarching conceptual framework that describes how key concepts are related, and how they contribute to a wider problem; that of handling competing demands in

healthcare systems. By adopting and potentially refining the framework provided here, or an alternative one that retains the key properties (of being clear and coherent), researchers will be able to conduct more precise analysis. They will also be better placed to understand the implications of their findings vis-à-vis the wider healthcare system.

### **7.7.2 Recognising the importance of context; using systems approaches**

In terms of recognising the importance of the context, the Literature Review showed that only a small number of extant studies have considered the role of context in shaping interruptions. The sociotechnical systems approach employed in the current study (Phase Two) proved helpful in illuminating how the clinical environment shaped the nature and handling of interruptions, hence future research might also consider using such an approach. However, several additions or refinements to the systems approach used in the current study might provide further insight. These include examining the perspective of multiple different types of healthcare stakeholders regarding interruptions, considering the role of time (i.e. as both a resource and a constraint) in the healthcare system, and reviewing the particular type of systems approach that is used.

Different stakeholders that can be considered part of the healthcare system include different types of clinician (e.g. doctors, nurses, physiotherapists, dieticians), patients themselves, and patients' carers. The study examined only the perspective of nurses regarding interruptions, but future research might wish to represent the perspectives of multiple different stakeholders. This could

illustrate, even more vividly than the current research has been able to, the ‘multiplicity of costs and benefits’ of interruptions.

Time was found to be an important part of the healthcare system – a vital clinical resource – and interruptions were critical in supporting time management (e.g. in allowing rapid responding to urgent events; in enabling nurses to maintain productivity in the context of a delay). While temporal constructs are implicit in many existing studies of interruption, future research would benefit from more explicit consideration of the role of time – both in terms of how time pressures add to competing demands, and how interruptions might support the handling of such demands. This might involve the detailed recording of task duration data, based on an empirical representation of the task (such as that derived from HTA in the current study) – and it might also involve the use of specific analysis techniques to illuminate temporal patterns, such as those associated with time series analysis. Such techniques might reveal underlying patterns in the clinical workflow, and, for example, highlight times when unplanned tasks are likely to require interruption (i.e. because individuals are already busy with tasks), and times when they might not (i.e. because individuals have capacity). Time series analysis could also be used to understand lag effects pertaining to interruptions i.e. the effects of interruptions on later – not only current – activities. Quantitative approaches to data capture and analysis might be necessary as such effects are not easy to observe qualitatively (time series analysis is primarily a quantitative analysis technique).

Regarding the particular type of systems approach that is used, researchers might in future consider using a more structured sociotechnical systems approach than that employed in the current study (see Waterson et al., 2015 for

a review of such approaches). The current study was informed by SEIPS, but this was used only loosely to guide the (Phase Two) research. A more structured systems approach might enable more systematic and detailed analysis, and it might better illuminate specific aspects of performance – or specific system outcomes. The STAMP approach (Leveson, 2011), for example, can be used to highlight the impact of various system features (e.g. safety control structure; self-regulation processes) on safety outcomes, hence this (or other similar methods) could be used by researchers most interested in interruptions' safety implications.

### **7.7.3 Considering interruptions in the context of other strategic and adaptive behaviours**

The finding that interruptions were just one of a number of strategies that supported handling competing demands suggests that future research might usefully examine interruptions within this context. Studies that consider interruptions in isolation (i.e. without considering how these may be combined with other strategies) are likely to produce only a partial understanding.

In addition to looking at strategic behaviours, the current study also suggests the potential benefits of examining opportunistic behaviours (e.g. taking advantage of the unexpected availability of a particular individual, or some other scarce resource required to complete a clinical task). As both strategic and opportunistic behaviours can support adaptation, it would make sense to examine these in parallel.



#### **7.7.4 The role of cognition**

The current study pointed to a wide range of different aspects of cognition that might be implicated in handling interruptions (i.e. in the wider context of competing demands), but which have been yet to be studied vis-à-vis healthcare interruptions. These include executive functions (e.g. mental updating and response inhibition), factors relating to experience (e.g. recognition primed decision making; associative memory mechanisms), and adaptive cognitive processes (e.g. see those described in the Macrocognition Framework; Klein et al., 2003; Schraagen et al., 2008). Future research should examine these, and, as with the previous point about strategic and adaptive behaviours, researchers should consider how such aspects of cognition are combined (i.e. used in parallel) to support effective task management.

The finding that the clinical context was crucial to the aetiology and handling of interruptions points to the benefits of naturalistic approaches to studying cognition. Future research could draw on the research methods developed by the founders of the Naturalistic Decision Making movement (e.g. Gary Klein, Robert Hoffman) – for example the critical decision method, ethnographic case studies, and the think aloud technique – to further illuminate how the context shapes interruption handling in dynamic, real world settings.

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## Chapter 8 Appendices

### APPENDIX A: DEVELOPING THE SEARCH STRATEGY

A variety of keywords and subject headings were examined in developing the search strategy. The term 'interruption' was first examined, and this produced a large number of relevant results – but also many irrelevant ones. Since many of the retrieved articles were not healthcare-specific, it was recognised that subsequent searches relating to 'interruptions', or similar concepts, would need to be combined with a term that increased the specificity of the results. The terms 'nurse', 'physician' and 'healthcare' (or truncated versions of these) facilitated this.

Keywords that were examined, but not ultimately used, included the terms 'distraction' and 'disruption'. 'Distraction' was found to produce a lot of irrelevant studies, relating to issues such as diverting patients' attention to facilitate the delivery of treatments (e.g. Inal and Kelleci, 2012; Martin, 2013). It also yielded few relevant articles not identified by the term 'interruption'. The term 'disruption' similarly yielded many inappropriate results, without adding any additional ones.

Subject headings that were explored included the terms 'attention' (EMBASE and MEDLINE) and 'distraction' (CINAHL). As with the search terms described above, these headings were found to add little to the sensitivity of the search, but they reduced its specificity. They were not, therefore, included in the final search strategy.

The four databases that were used CINAHL, MEDLINE, EMBASE and PsycInfo were selected on the basis that they are among the largest and most comprehensive repositories of health and medical research.

It was clear in developing the search strategy that the term 'interruption' has been used to refer to a variety of distinct phenomena. The term was used, for example, to describe discontinuity in drug infusions, or intravenous feeding (e.g. Stoian et al., 2011; Williams et al., 2013) clinical interventions in which treatments or doses are 'spaced out' (e.g. Gazarian et al., 2010); clinicians' 'interrupting' (preventing) errors i.e. by recognising, and/or remedying, individual or system failures (Rothschild et al., 2009; Dykes et al., 2010; Henneman et al., 2010).

However, the most frequent use of 'interruption' was as we have used it; to describe the occurrence of unplanned tasks or events, disruptions to the workflow, or discontinuity in a clinician's attention. Only studies in which these issues were a main focus were included in the current review.



## APPENDIX B: LITERATURE REVIEW STUDIES PUBLISHED PRIOR TO 2009

*Table 8-1 Key features of counting and categorising studies*

First Author, Year	Setting	Participants / sample	Methods	Results
Blum and Lieu, 1992	A major paediatric teaching hospital in the US	Some 18 medical interns took part	The interns kept logs of all of the pages they received	Almost half of all pages received by interns interrupted patient care, 24% interrupted scheduled work rounds or teaching sessions, 34% of pages gave rise to revised treatment plan. Interns considered some 25% of all pages that they received as unimportant.
Brixey et al., 2008	The Emergency Department of a major US urban medical centre	Physicians and nurses in a level one trauma centre. Five physicians were observed for almost 30 hours. Eight nurses were observed for 40 hours.	Ethnographic case study involving shadowing observations, and behaviour coding.	Key sources of interruptions included people, pagers and telephone calls. The physical environment also contributed to interruptions e.g. design issues and a lack of supplies led to many interruptions. Nurses were interrupted more often than physicians. Only rarely did staff fail to resume an interrupted activity.
Chisholm et al., 2001	Emergency Department in five US community hospitals. Some 22 primary care offices also involved	More than 20 emergency physicians and over 20 primary care doctors	Time and motion data collection. Key variables included interruptions, tasks performed, multitasking events.	Emergency doctors were interrupted almost 10 times per hour on average, while primary care doctors were interrupted almost 4 times per hour. Primary care doctors multitasked for more than 10 minutes per hour – compared with around 6 minutes for emergency doctors. Primary care doctors spent more time delivering direct patient care, and emergency physicians spent longer on analysis and charting.
Chisholm et al., 2000	Emergency Departments in three hospital settings – one urban, one suburban, one rural	Some 30 Emergency Department physicians took part in the research	Emergency department physicians were shadowed for 3 hour sessions. They recorded tasks and interruptions.	More than 20 tasks were performed per hour, and there were around 10 interruptions per hour. The number of interruptions was positively associated with the average number of patients handled simultaneously.
Coiera et al., 2002	Two emergency departments (one rural and one urban) in Australian hospitals.	Twelve clinical staff members were involved: six nurses and six doctors.	Structured and unstructured observations, recorded conversations	Around 1300 communication events were observed in 35 hours of observation. One third of communication events were interruptions and such events occurred more than 10 times per hour on average. More than 10% of clinicians' time was spent having simultaneous conversations (i.e. speaking with two or more colleagues at the same time).

First Author, Year	Setting	Participants / sample	Methods	Results
Fairbanks et al., 2007	Three wards: emergency, acute adult & paediatric departments of a US hospital	Some 8 nurses and 16 physicians participated in the study	A prospective observational study design, used observations and link analysis techniques.	Almost 1700 communication events were recorded during around 40 hours of observation. Face-to-face communication was the most common channel for interruption. In the adult area, interruption rates varied considerably, ranging from 0.5 per hour for bedside nurses, to 7 per hour for attending physicians. The equivalent figures for these doctors in the paediatric ward were 0.3 to 3.6.
France et al., 2005	The Adult Emergency Department at Vanderbilt University Medical Centre	The study involved 10 post-graduate and resident physicians	Time-and-motion observation study of how clinicians allocated time	Clinical activities were interrupted more often than direct patient care. Workload scores for faculty physicians were lower than resident physicians. Physicians at all levels considered time demands and psychological demands as the most significant pressures that they faced.
Friedman, 2005	The Emergency Department of a teaching hospital	Some 11 Emergency Department physicians ranging in age from 29-55 with 1-35 years' experience	Observations were conducted using a standardised coding system.	Patient interaction and medical notes review took up much of physicians' time. Physicians were interrupted 400 times with nearly 10% of interruptions requiring movement of 3 metres or more. The most common sources of interruptions were nurses, physicians, and relatives. The rate of interruption was associated with shift intensity (the delay from patient registration to doctors' assessment).
Healey et al., 2007	An operating theatre in a teaching hospital	The study involved 4 consultant urologists and their surgical teams	Structured observations with coding framework re. distractions and interruptions.	Distractions and interruptions occurred frequently, and the degree of effort required of surgical teams to handle these was high. Distractions and interruptions stemmed from telephones, beepers, equipment and procedural problems, among other factors.
Healey et al., 2007	An operating theatre in a teaching hospital	A surgical team of anaesthetists, surgeons, nurses and assistants	Structured observations with coding framework re. distractions and interruptions.	Interference levels were associated with door opening frequency. Interference including equipment, procedure and environment was inherent to the work performed by the surgical team but other events were peripheral, including beepers, phone calls and external staff.
Kreckler et al., 2008	A Surgical Ward in a teaching hospital	The study looked at 38 drug rounds	Basic pro-forma freehand notes recorded descriptive observations	Interruptions made up 11% of each drug round. There was at least one interruption in two-thirds of the rounds studied. Of all the interruptions, over 20% came from doctors, with other nurses, patients, telephone calls, relatives and the nurse conducting the round making up the remainder. in
Rhoades et al., 2001	The primary care outpatient clinics of a teaching hospital	Some 60 primary care office visits. 22 family practice and internal medicine residents participated	Observations were conducted using a standardised collection form, with a coding system.	Medics spent an average of 11 minutes with each patient, with the patient speaking for around 4 minutes. Patients spoke for 12 seconds on average after the doctor arrived. Female medics interrupted their patients less often than male medics. All medics interrupted female patients more often than male patients. Medics interrupted patients before they finished speaking 25% of the time, and twice per visit on average.
Sevdalis et al., 2008	A UK hospital	Some 16 surgeons, 26 nurses and 20 anaesthetists/ operating practitioners	Structured observations using an associated coding system.	Participants in the study concluded that specific issues, the environment, and communication issues affect others more frequently and more significantly than themselves. Surgeons reported fewer disruptions than nurses or anaesthetists.

First Author, Year	Setting	Participants / sample	Methods	Results
Sevdalis et al., 2007	The operating rooms of a teaching hospital	The study looked at 48 general surgery procedures	Observers recorded the initiator and the recipient of communication events that were not relevant to current activities	Many communication events were classed as irrelevant by staff. Surgeons were found to be the most likely instigators and recipients of irrelevant communications. External staff visiting the operating theatre prompted the most distracting communications.
Spencer et al., 2004	The emergency department of a large teaching hospital in Australia	Four medical officers and 4 nurses were observed for almost 20 hours	This was an observational study	The study identified 831 communication events with an average of 42 events per person per hour. Almost 90% of clinicians' time was spent in communication. Interruptions made up one third of communication events, with an average of 15 interruptions per person per hour. Senior medical and nursing staff faced more interruptions than junior doctors and nurses.
Tang et al., 2006	An ICU remote monitoring facility	Some 7 nurses with 40 hours of observation	Structured observation with an associated coding system	The study reported that nurses' tasks fell into three groups: monitoring patients, maintaining patients' health records, and managing technology use. Nurses spent over 50% of their time assimilating information inserted in a clinical information system and 15% on monitoring live vitals.
Tucker and Spear, 2006	6 major US hospitals	Some 11 nurse participants	Primary observation, semi-structured interviews, and surveys of hospital nurses.	The five most frequent types of failures identified in the study involved medications, orders, supplies, staffing, and equipment. Nurses experienced over 8 work system failures per 8-hour shift. Survey questions which asked nurses how often they experienced these obstacles showed comparable frequencies.
Westbrook et al., 2008	A large teaching hospital in Sydney, Australia	Some 19 doctors (seven registrars, five residents, seven interns) in four wards were observed for a total of 151 hours	Observational study – time and motion	Professional communication, social activities and indirect care made up the greatest proportions of doctors' time. Multitasking made up 20% of time, and doctors were interrupted every 21 minutes on average. Most tasks were completed with another doctor, 24 were undertaken alone and 15% with a patient.
Woloshynowych et al., 2007	An inner-city hospital Emergency Department, London	Some 11 charge nurses were observed for over 20 hours	Structured observation study, used a standardised behaviour coding system.	Some 2,019 communication interruptions were observed for 20 hours. Around 3/5 were initiated by the charge nurse. The largest purpose of communication events regarded patient management (nearly 50%). Higher nurse staffing was associated with fewer communication events with the nurse in charge.

*Table 8-2 Key features of interruption effects studies*

First Author, Year	Aim (p. no.)	Setting	Participants / sample	Methods	Results
Christian et al., 2006	To obtain a description of the system and its components in order to identify features that influence patient safety.	A teaching hospital	The study involved observations of 10 general surgery cases	Prospective observations of general surgery cases in a teaching hospital were conducted.	The study found that problems with communication and information flow, workload and competing tasks had a negative impact on the performance of the team and patient safety in all cases. The counting protocol was found to impact case progression and patient safety.
Flynn et al., 1999	To evaluate the impact of interruptions and distractions on the number of dispensing errors	A pharmacy in a general medical–surgical hospital	Some 14 pharmacists and 10 technicians	Videotaped observations were employed	Some 5072 prescriptions were analysed, and 164 errors were detected. A total of 2022 interruptions and 2457 distractions were identified. Interruptions and distractions per half hour were significantly related to errors.
Hillsden and Fenton, 2006	To identify areas of practice that could be improved to reduce medication errors.		The study involved 5 medication rounds with prescribing and recording sheets for 20 patients	This was an observational study with a retrospective audit of medication documentation	28 interruptions were identified during 5 medicine rounds and 2 errors were observed (one of which caused by interruption). Interruptions were grouped as avoidable and unavoidable with themes identified. A number of serious issues such as allergies not being recorded were highlighted by the audit.
Palese et al., 2008	The purpose of the study was to examine the frequency and perceived risk of interruptions to nurses during drug rounds in seven Italian surgical wards.	Surgical wards	56 randomised drug rounds were observed and 28 observed nurses were interviewed.	An observational study design was developed and used	Observations took place of the administration of 945 medications. 298 interruptions were noted and 10 categories of interruption emerged. Nurses felt that the highest risk of error as a result of interruptions related to the organisation of telephone calls.
Scott-Cawiezell et al., 2007	To determine the impact of levels of credentialing among nursing home staff on medication error. The impact of distractions and interruptions was explored.	The study took place in 5 nursing homes	Some 39 medication administrators	Direct structured observation was employed	The study found that level of credential made no difference to medication error rates. Registered nurses experienced more interruptions during medication administration, which in turn were associated with increased medication error rates.
Wiegmann et al., 2007	To study surgical errors and their relationship to surgical flow disruptions in cardiovascular surgery to better understand the effect of these disruptions on surgical errors and ultimately patient safety.	The operating rooms of one medical institution	Observations of 31 cardiac surgery operations over a 3-week period	Structured observations together with a associated coding scheme	The study concluded that disruptions comprised teamwork/communication failures, equipment and technology problems, peripheral interruptions, training-related distractions, and issues in resource availability. Teamwork/communication failures were the best predictor of surgical errors.

First Author, Year	Aim (p. no.)	Setting	Participants / sample	Methods	Results
Zheng et al., 2008	To identify activities performed... in the operating room not directly related to the achievement of the surgical goal.	Operating rooms of a large hospital	Some 12 observed cases	An observational field study was conducted in the operating room to observe disruptive events during surgery.	The study found that on average 114 disruptive events occurred per hour. The highest frequency and longest duration conversations were intraoperative; but most conversations did not delay surgical workflow. Instrument changes generated the most surgical delays. Disruptive events caused more than 4 minutes of delay for each case per hour.

Note that this appendix includes only 2 of the 5 study types identified in the Literature Review: ‘counting and categorising’, and interruption effects studies. Relatively few studies were published prior to 2009 in the three other categories (intervention studies, interruption handling studies, and healthcare complexity studies), hence these were included in the main body of the review.

## APPENDIX C: PHASE ONE INTERVIEW SCHEDULE



### Semi Structured Interview Topic Guide

#### 1. Introduction

\*Reintroduce self, NNRU

\*Reintroduce research (reminder of research background, aims, objectives)

\*Explain:

- Why nurses have been selected for interview
- Length and nature of interview – c.60 minutes; specific topics to address, but interview will be conversational in style, in your own words.
- Explain topics to be covered
- Confidentiality will be absolute. All personal information anonymised
- Note taking and audio recording – data storage and any report
- Consent and right to withdraw – you have already consented but can withdraw at any time during, or after, the interview, up until December 2013
- Unlikely that the interview will cover sensitive or contentious issues but if you feel upset or distressed we will suspend, or terminate, interview. If you decide to terminate the interview, we will not attempt to reschedule – unless you indicate that you would like to.

#### 2. Individual Background

*Aim: to gather contextual information about the participant which may have a bearing on their experiences, and can be followed up and explored during the interview.*

- Band? How long worked in NHS trust? How long in the current role?
- Nurse education; previous experience of nursing?
- Personal background relevant to your work?

### 3. Views on Work in General

*Aim: to learn about participants views regarding the clinical context, work organisation, working styles and other aspects of their jobs which may affect how they think about, or how they actually perform, Multiple Task Management. We will ask about:*

- Tell me about the main tasks that you have to do in your job?
- I have a number of Qs regarding the main demands of your job?
  - can you describe the main tasks that you have to do in your job?
  - are there any tasks which you regard as particularly important? In what ways are they important?
  - what do you regard to be the main skills required to do your job well? do you need to use a wide variety of skills?
  - can you tell me about the physical work involved in your job?
  - tell me about your workload and time pressure?
  - to what extent do you have control over how you do your work?
  - can you tell me about the coordination demands in your job (e.g. the need to make sure that drugs, tools, technologies, other HCPs are available when they are needed)?
- Regarding the work environment on your ward (e.g. in terms of the ward layout, lighting etc), how appropriate do you feel that this is for patients and for staff? What changes would you make to improve the environment?
- Tell me about aspects of your job that you enjoy, and aspects that you don't enjoy – and please explain why you like them – or don't?
- Which aspects of your job do you find most difficult or challenging?
- What aspects of teamwork are there in the job? Can you tell me about any specific tasks where you need to work as a team?
- How is information communicated within the team? How well does this work? What, if anything, would you change about how information is communicated – and why?

- How well does the team work together?
- How are relationships between members of the team?
- How much do you have to interact with people in other departments?  
Which departments do you interact with and why?
- How is the management of your ward? What, if anything, would you change about how the ward is managed – and why would you do this?
- In terms of the tools, technologies and equipment that you use in your job, how suitable are these/ well do these work? Is there any equipment that you wish you had and/or that would help you to perform well in your job?
- What do you think the patient experience in A&E is like - please explain why?

#### **4. Interruptions**

- To what extent do you have to manage unplanned tasks and interruptions during your work?
- What are the main reasons for the interruptions that you have to deal with? [probes: who or what tended to instigate the interruption? What were you doing at the time of interruption? What did the interrupting task involve?]
- How do you manage unplanned tasks and interruptions? [probes: do you always attend to them immediately?; do you delegate?]
- When are interruptions most difficult to deal with? Are there any tasks that are interrupted more than others? Which ones and why?
- Tell me about a time when you had to manage a particularly challenging interruption – or a series of interruptions. [probes: how did



you cope with this? Tell me what happened? What would you do if faced with the same situation again?]

- To what extent are interruptions initiated by others, rather than by yourself (i.e. through 'self-interruption'?)

**6. Thank Participant and Close**

- Thank participant very much for their time and for engaging
- Explain what we will do with the information that they have given us
- Explain how participants can see the results – a summary will be provided
- Provide information regarding sources of help or support if necessary

## **APPENDIX D: PHASE ONE EXAMPLES OF RAW DATA**

This section includes examples of all of the main sources of raw data – including observation notes (qualitative data recorded in real-time during non participant observations), fieldnotes, and nurse interviews – for each of the study settings. Individual's real names have been removed or disguised to protect their identity.

### **Appendix D1: Example data from A&E**

#### ***Observation Notes (observation session 5)***

13.45 -I begin at 1345. It is moderately busy but not hugely so

- nurse has just taken over as Nurse In Charge (NIC)
- I ask the NIC about the main NIC screen on the nurse computer system
- when nurse takes over as NIC they have to fill in the ED activity sheet which includes transport requirements, missing patients, "blue calls"
- also, NIC must help to keep the nurse computer system updated.
- have to keep the ambulance computer system (CMS) updated as this shows availability to ambulances. The unit has an incentive to show availability as that is how they are funded!
- nurse updates NIC system but is interrupted by doc (unplanned task)
- doc comes over to update nurse on a patient transfer. Nurse also tells doc that a patient has gone AWOL. Doc tells nurse that the patient has gone to resus
- somebody rings to ask how a patient is -not sure if caller is patient relative or a clinician - think it is the latter. Nurse reads info from [nurse computer system] to caller. Nurse cannot answer all questions - so asks registrar. Tells nurse what happened. After call I ask the NIC who was on the phone - it was a clinic in [Wing X of the hospital] - it seems that the patient did not know why they had

been sent to this Wing. But NIC could not find nothing in the notes regarding why they needed to go to said wing!

14.00 -other charge nurse asks nurse if she needs help- they look together through the notes but still nothing

-doc interrupts (distracts?)- tells NIC that they are moving a patient to CDU

-patient shouts 'is someone coming to me'. This patient asked for a pillow 15 mins ago and was ignored. Not sure if the NIC heard him

-nurses continue discussing why this gyn patient has been referred to [wing X]

-doc overhears and intervenes. Looks at system and tells them that patient is known to [wing X] so they should know what to do. SHOWS IMPORTANCE OF CHANCE OVERHEARINGS

-NIC does handover from paramedic. Normally the triage nurses does this, or one of the float nurses, but NIC is covering them now (because they are busy). Patient says that his chest is really hurting. Paramedic says that it is stomach acid. Nurse takes copy of document from paramedic [PRF form]

-NIC said she would always help with the triage when it gets busy – but especially when patients might breach the 4 hour wait time.

-NIC walks down corridor to patient in seat located opposite waiting room-next to gas room. She tells the patient they are getting her meds

14.15 -gets meds from room opposite patient. Tells them it is gaviscon and it will help with the burning nurse-patient comm

-nurse tells me that they need to do a round every now and then to keep track of everything that is going on – *including outstanding tasks on their to do list*

-another nurse comes to see NIC – but she is on the telephone. NIC finishes call and answers the other nurse's question. The NIC then tells the nurse that triage need help-they have 6 people waiting [I think this is the info that was conveyed in the phone call that NIC just received]

### ***Fieldnotes (observation session 5)***

- Switching and interrupts required not just because of unplanned tasks, but also because of need to coordinate tasks across the (physical) department... but it was not just coordinating in space – nurses also needed to coordinate in time e.g. they needed to get certain jobs done by a certain time (e.g. NIC needed to get a referral done by a certain time so the patient could be collected by a porter at the said time etc)
- More evidence here regarding interrupt benefits described previously. NIC started referral but could not finish on several occasions. She switched jobs to keep productivity going. This also links to anticipating strategy that I mentioned elsewhere... the NIC knew she would have to maintain productivity because she could anticipate that there were bound to be many unplanned tasks [incl many new patients!!] later on...
- Over many, many short interactions, nurses shared very detailed information... This is helping them to keep on top of what going on in the department as a whole.. which they needed to do to handle competing demands
- And many interruptions themselves helped nurses to maintain awareness of important events in the department e.g. the NIC intervened on numerous occasions demonstrating that she had overheard other clinicians talking...
- NIC took advantage of lots of walking to monitor and check on patients. She would interrupt her walking around the ward to do this monitoring... Maybe keeping track of patient status helped her to anticipate events?
- There was lots more evidence of the different experience related strategies mentioned in previous sessions e.g. spotting a valid task

## ***Interview Data***

INT=Interviewer (the author)

RES= Respondent

INT           What do you regard as your key tasks when working in A&E?

RES           It depends which part of the department I work. Every time, the task is different. As a general thing, of course you have to look after the patient, that's your job. But actually, it depends. Where I'm working every shift, the task is different, because the emergencies are different. It's different requirements. If I'm triage and I have to... when I'm triaging out at the front, I have to stream basically to find out if a patient has to stay in minor or has to go to major, or what kind of investigations to initiate. And if it's really serious, where to put him; to put him in resus, to put him in major, to put him on a monitor. In fact, resus is a different thing. He's going to come with a Code Blue or a Trauma Code and I have to prepare to get ready for the emergency that's coming.

INT           This is helpful. This is the kind of...

RES           It depends where I am. There are all these changes. I have different kinds of tasks to perform.

INT           When you're in majors, what do you regard as the main tasks?

RES           First and foremost, basically it's the safety of the patient, as a general rule. Somebody is handing over to you four or five patients, and you have to look after them, you have to make sure that they're stable, and to meet their needs. They have to give

painkillers, and to initiate investigations, the same thing approached from a different kind of angle, or you do different kinds of ward routines.

INT            Okay. I've got a number of questions about the main tasks or the demands in your job. Are there any tasks that you regard as particularly important, and can you tell me in what ways you see them as being important? Now, you already alluded to patient safety.

RES            Yeah. They're the most important to me. Of course, people phrase that in a different way. The most important thing is the communication. And most of the time to make the patient safe, communication. I want to say 'assessment', but it's communication. Good communication. If people can understand what you say and you understand what they are asking back, more or less, a good assessment means you're going to be able to meet properly their needs. That's very, very important whenever you are in the department. If you are able to make the proper questioning, to phrase it in a way, because you are going to hear – you've got to concentrate – 'My problem is this, this, and that, and because of that I am here.' The better they get that, the faster you are able to act on it. It of course depends on your knowledge. Sometimes they say things that I don't know really, even now, that you think, 'God, I don't know, really.' Like I don't know what to put, what to do, I don't always...

INT            Tell me just a little bit about the physical work involved in the job.  
                 As in...

RES            Everything is very physical, yeah, if that's what you mean.

INT            What do you see as the most physical things you have to do? It is  
                 a very physical job, isn't it?

RES            Yeah, it is.

INT            What things in particular?

RES            I don't know, everything. Some things you cannot do by yourself.  
                 You need a hand. For example, even to undress a patient that is  
                 really bedbound, and he doesn't have any mobility, if somebody is  
                 there, you need a hand to undress them, to do certain things, to  
                 move somebody, to change somebody. All of it, they need a hand.  
                 Even just to... but it is very physical. You're in very close contact  
                 with people. You help them to move, you help them to, you know,  
                 all the time. You do things with your hands, from the simple things  
                 to taking temperature or blood pressure to taking bloods.  
                 Everything is physical. You move around, you are standing.

## **Appendix D2: Example data from Surgical Ward**

### ***Observation Notes (observation session 5)***

13.15 -particular context for the day: nurse working in HDU with one other nurse

- wheels patient bed into h4 with porter
- closes curtain - Goes behind curtain
- nurse comes out from behind the curtain to put some gloves on
- I ask about the patient who has arrived - he is from recovery
- nurse tells visitors of h1 that it is outside of visiting hours and as such they can only see patient one at a time
- nurse goes back behind curtain but as she does so, her nurse colleague in HDU calls her interrupts and explains that she is going somewhere - they then have a quick conversation which I don't catch
- nurse talks to the patient - but it is a private conversation
- she comes out from behind curtain to get supplies from the trolleys next to the window
- as nurse heads back, patient in h1 asks questions about security of the ward – (unplanned task). Perhaps he was in a fight or something and fears reprisals (I later found out that he was stabbed). Nurse reassures him and then goes back behind the curtain
- goes out to get a trolley and some water for the patient
- other nurse comes with some supplies and gives some to nurse x

1330 -nurse x goes to supplies room-comes back with a big tube - I ask what this tube is for - its for inflating the lungs - or something - says it is a cpap system - with mask, harness and filter - describes itself as a complete respiratory system

- doc stands next to h4 patient - has a v quick word with the nurse but they are still behind curtain do not sure what they are saying



- Nurse comes back to nurse's desk next to the window in hdu - and chats with the other nurse briefly. They chat about the security concerns raised by the patient in h1
- nurse remains behind curtain
- nurse comes out from behind the curtain - opens curtains
- I ask what is wrong with h4-patient has sickle cell apparently - and he also had gall bladder removed - he seems to be on quite complex breathing apparatus!
- nurse preps meds - has a bag of iv fluids and related kit
- puts meds in a tray
- dietician arrives and asks nurse x if they had been waiting for her re h3 - nurse x says yes! Delayed task WHY IS THIS NOT AN UNPLANNED TASK?!
- nurse flushes patient line, then hooks up iv bag
- another nurse comes and asks a question- they have a conflag about patient h4
- they speak quietly so I can't hear. (Unplanned task/ interrupt)
- I ask who the nurse was - he was a ENP from resus - nurse asked him whether she had set up the kit for h4 properly - she says she was confident but wanted to make sure safety – taking precautions
- call bell goes but it relates to b bay *distraction*
- someone comes around with a birthday card - nurse signs the card (unplanned task)
- dietician comes over and asks a question about patient's meds

### ***Fieldnotes (observation session 5)***

- 10) As expected, there were A LOT of unplanned tasks – more even than in A&E – or so it seemed. The need to obtain particular resources – sometimes that meant a particular individual, sometimes just having access to some object (e.g. the controlled drugs cupboard key), or it could be a machine to monitor a patient or run a test – meant nurse had to suspend lots of tasks for a period of time. This caused delays in these tasks – but of course the nurse got on with other things so she didn't have to wait around
- 11) Further evidence could be seen re experience and how this with interrupts and competing demands in general. The nurse anticipated problems with patients respiratory equipment so she asked someone to check it... not sure a less experienced nurse would have known to do this.
- 12) The nurse perhaps also showed her experience in rejecting several unplanned tasks that she felt were unnecessary (see observation notes re nurse's handling of HCA requests)
- 13) There were more interesting observations re how and when nurses interrupted – and interesting things they seemed to take into account. More evidence re role interruption duration and difficulty. Nurse deferred several harder/ longer tasks (e.g. taking out a patient's drain, helping the charge nurse with planning), but almost always dropped everything immediately when faced with a small or quick job
- 14) When people were around who the nurse needed to see, but whom she could not easily access (especially the medical team – but also people such as the dietician and charge nurse), she had to prioritise seeing them. This meant that she often interrupted a task as she had to take advantage of chance encounters to ask questions....

### ***Interview Data***

Okay. If I can just start just by asking you a little bit about your own background.

RES            Yeah.

INT            Can you tell me how long you've been on the ward for?

RES            Just over two years. Two years in June.

INT            Okay. And before that were you newly qualified at that?

RES            No, I worked a year in [Hospital name] on a colorectal ward.

INT            And was it a similar kind of set-up to here?

RES            Yeah. It wasn't as busy.

INT            Okay. So it was a colorectal ward, and in terms of the kind of demands and pressures that you faced, were they similar or just very, very different?

RES            They were similar, but I think because some patients here have had such major surgery, they seemed to be more independent.

INT            Right, as in they were more able to do...

RES            To do things. And there's also a lot of different cultures here...  
culture

INT            Sure.

RES            ... which it sometimes affects things.

INT Sure. In terms of... do you mean communication between staff, or did you mean diversity of patients, or staff, or both?

RES Diversity of patients, yeah.

INT And just without going into too much detail, because obviously this is quite a personal question, but I'm just interested to know that in terms of your own personal background, which relates to... because obviously inevitably if there are five children running around at home, inevitably work-life balance is difficult.

RES No, I live with my boyfriend who I've been with four years, and I always make sure I nine times out of ten do something on my day off so I'm relaxed. Nurse wellbeing

INT Sure, that's good. So in terms of when you're here, are you able to get home at a reasonable time as it's sort of...

RES It's an hour commute. Most of the time, yes. But sometimes you just can't leave on time, and you do end up getting home very late.

INT Sure, which I guess is hard, but I suppose you have your few days off afterwards.

RES Yeah.

INT Okay. I imagine that you've always worked the 12-hour shifts, have you?

RES Yes.

INT Even when you were on the colorectal ward?

RES Yes.

INT Okay. Thank you for the little bit of that, it's just useful for me to understand what kind of pressures you face individually. I'm now going to move on to ask some very unstructured and open questions about the ward environment and what it's like to work here, really. I'm just going to ask you, start with a really, really open question, and just ask you, can you tell me about the environment on the ward, key things about the environment?

RES It's extremely busy. Patients are acutely unwell. And there's a lot of demand for beds. And it seems to me more demand... like it does get that, but it seems to be a lot of pressure on beds. It's also got the high dependency unit, so sometimes, like today I'm in there. So it can differ as to what kind of patient you look after as well. Workload and demands

INT How often are you on the HDU?

RES I was permanent in there for six months, but I fancied a change and I wanted to come back out on the ward. The HDU is very structured, routinized? and even though it's a brilliant learning environment, I just prefer the ward.

INT Sure, yeah, I can see that, the HDU is very intense. There's no... there's maybe a lack of variety in some respects. Job variety!

RES Yeah.

INT Whereas the ward seems, you know, you seem to be doing a greater variety of jobs and so you have a different variety of

patients as well. And you're communicating more with people in a sense, aren't you?

RES Yeah.

INT And can you just tell me what you see as the main demands of the job? I suppose I'm not talking just in HDU, but when you're on the ward more generally, what are the main demands?

RES You've got the demands of the patients. The medications, ensuring they're washed and dressed, their fluid balance charts – because they're so important when a patient is post-op – everything, really. Their wounds, hygiene needs, making sure that their emotional needs are met as well. We get quite an age range here, so it can be very different depending on the age and the sex of the patient as to how you communicate with them. Main skills – incl ability to adapt for diff patients

INT And does that affect how you prioritise things as well?

RES It can do.

INT In what kinds of ways?

RES You sometimes... I think you have to appreciate that a lot of these patients have got, you know, cancer or something,. So you do have to take that extra little bit of time and make sure you are making sure that the priorities, like their fluid balance chart... but to them, that's not their priority, they just want to sit and talk to you. But you have to make sure you sort of do both.

## **Appendix D3: Example data from Day Chemotherapy Centre**

### ***Observation Notes (observation session 4)***

- Nurse says day has been quite busy so far – but not as mad as it could have been. Ward is short of one sister as [nurse name] called in sick
- Old lady (p1) arrives for transfusion - she is late (due at 9 and it is now 1010)
- next patient arrives around the same time
- old lady P1 is taken through to treatment area and is taken to a bed (bed 2)
- lifting patient - good example of a multifaceted task
- nurse speaks with patient's son about her treatment
- looks to put Cannula in
- nurse checks that blood is coming back?
- tells me re extravasation protocols – these dictate what you have to do when administering chemo – different chemo drugs have different procedures
- gets heat pad to help bring out the vein
- need to take 2 containers of blood for a blood test as patient has never had a blood transfusion - takes patient word for it
- nurse interrupted by a colleague requesting that she goes to speak to one of the senior nurses (sister)... Nurse was in the middle of labelling bloods! This is another unplanned task!
- name tag put on patient
- nurse explains the reasons why cancer patients have blood transfusions: haemorrhage, anaemia, radiotherapy
- nurse interrupted by ward sister to have the conversation (mentioned above) re why some aspects of diagnosis missing - nurse says that patient notes were missing SAFETY; INTN/ UNPLANNED TASK

- mentions issues re wigs to patient – the Raquel welsh ones are very good nurse says!
- washing hands before putting Cannula in to second patient (first patient's initial treatment – but not the transfusion is currently in process - so nurse has to switch between tasks a lot)
- has to help old lady P1 to move in bed (this is the first patient who will be having the blood transfusion later)
- has a drink of water
- hooks up the drip and preps all meds
- interrupted again by one of the ward sisters - asking what happened to a previous patient
- carries on with prep SWITCHING
- interrupted again by patient asking for their hospital number
- nurse explains procedure to patient while continuing prep
- puts Cannula in and talks to patient at the same time
- Cannula goes in first time - hooks up IV
- puts in the anti sickness through hypodermic - continues to talk to patient
- tells patient that the cold feeling is normal - continues to talk to patient all the time - although patient is a first timer
- updates status sheet re patients that have been brought through to treatment room
- Chemo retrieved from fridge
- check consent
- ask someone to check chemo
- importance of humour in coping!!!
- nurse goes to get name tag – she forgot this first time



#### ***Fieldnotes (observation session 4)***

- 15) Interrupts and competing demands more generally managed in the context of the wider workload... but one thing that is missing is that clinical, social and organisational constraints are also part of the equation. In other words, competing demands have to be handled with these constraints – and these constraints cause competing demands e.g. speed Vs safety have to be traded off against each other
- 16) The chemo ward shows how frequent switching can enable concurrent performance. Nurses often had to manage multiple patients at the same time... infusions often took a long time to run and nurses could not simply stand around waiting while these were delivered.... So they generally hooked it up and started an infusion for one patient, before then switching to another activity e.g. doing the same for another patient. They relied on the infusion pump alarms to remind them when patients' drugs had finished – and to prompt them re need to hook up the next treatment (most patients had multiple treatments)
- 17) There were a few good examples this morning re benefits of interruptions. Further evidence found this morning of interleaving (rapid switching among interdependent tasks)... Nurse frequently switched between completing her notes (for each patient she had treated in the chemo centre) and checking records. Good example of mutually beneficial tasks (these two tasks were mutually beneficial.... Also see observation notes re examples of how interruptions were used to respond rapidly (to a potential extravasation event), and to obtain required information.

## ***Interview Data***

- RES           The pathway is patients are coming one day before like...
- INT           Sure. To Clinic X.
- RES           ... yesterday, Clinic X Friday. They have their bloods done, and then the doctor is looking for the blood results. If they are okay, then Clinic X will fax the chemo script to pharmacy. Then if there is any problem, the system is in place that they should highlight if they haven't got a script or if there is a problem with the bloods. So in the morning when we come, we know that if its colour is green, it's alright, and the script is in pharmacy and the patient is okay to go ahead. Red, it means there is a problem with the script, they haven't got a confirmation. So we need to chase what the problem is – the bloods, or dose reduction, or the patient maybe didn't turn up to Clinic X, so we have to chase that. And if it's a yellow, that means only half of the treatment is ready. On my computer we have this system of knowing what is going on with the script.
- INT           And from what I observed, you guys have to spend a lot of time chasing things up and trying to coordinate everything.
- RES           Yes.
- INT           Because you guys are the ones who have to do it for the patient, and it has to be there ready there and then when the patient arrives. So it seems to me like a big part of the job is about coordinating different things all at once, such that they are ready as and when the patient comes.

RES Yes. Another part, for example, is the Herceptin scripts, which we have to make sure that they are done in advance. And if they are done in advance, if they are done in pharmacy aseptic, then they would prepare it for us. So we don't have to chase on the day, even though it's happened before, because it got missed for example, the scripts to be done. Or either a registrar wasn't there to sign it, either they forgot. Or, for example, if the patient forgot to have an echo scan done, then we need to make sure that every three months precisely they have the heart check, because for Herceptin, it's toxic, cardiotoxicity is very important. And also sometimes we have to chase the pharmacy, the aseptic, because if they are short of staff, they will let us know in the morning. And then our job is that we inform the patients to understand that pharmacy is short of staff and that they might have to wait an extra maybe half an hour.

INT So you ring the patients in the morning just to tell them, 'It's a very busy day, the pharmacy is short-staffed, it might be-'

RES Because what I've noticed here is a very good system, because if you know that the patient let's say is scheduled for twelve o'clock or eleven o'clock, and you know that there might be a delay, we go outside to the patient and let them know, 'Sorry, there's been a delay, they're short of staff in the pharmacy, and all the treatments will be delayed. So we cannot say exactly how long it will be, half an hour, one hour, but just stay with us, we will give you the treatment, and we do apologise.' And the patients' feedback is, 'Thank you for letting me know.' Because now they know what...

maybe they can go out to have a cup of tea, maybe they can go out on the street or the park and then come back at twelve o'clock, one hour later. So that's what I did with my patient today, sent him out for one hour and then he came back.

INT        Yeah. I think it makes a lot of difference to people, doesn't it, just to know what's going on, just to know...

RES        I think this is the feedback that we receive from most patients, because they feel like they are in – not in control, but they are informed, and they feel like they are equal partners in their care. And I think this is very important for them.

INT        Absolutely, absolutely.

RES        I mean, I would like to be treated the way I treat my patients. That's my motto. That's the way I behave. And I think that if I am to have cancer and I'm going to treatment, I would like to be told, 'Yes, there is a problem with your treatment, you will be treated one hour later,' and then I will know.

INT        Absolutely. I know we've touched already on issues about workload, but I'm just interested to know how you find your workload. I know you've said that you find it better, for example, here than in other hospitals. I suppose rather than comparing it to other hospitals, I'd just like your thoughts in general on your workload. Is it high? How...

RES        What I believe is that some days – not every day is the same, because every day is different. And every day, the workload

differs. Some days I'm more busy than others. I've noticed that on a Wednesday and Thursday, they are the busiest days, when we have five to six patients, each nurse. We have the patients scheduled to come at let's say 10:00, 10:30, 12:00, 12:30, 2:00, 2:30 – we have a lot of gap, like one hour to one hour and a half. But bear in mind that at one time of the day I will have to look after four, five patients at the same time, which they require either clinical saturation, they require chemotherapy, bag changes. They require different tasks in the same time. And sometimes I find it hard to leave four, five patients to go on my break. I prefer to postpone my break *[laughter]* half an hour to make sure that all the patients have had their chemotherapy bags changed on time. Because nobody likes to sit there for 15 minutes knowing that their chemotherapy bag has finished, but the nurses, we don't know where. And then we see four, five machine bleeps around you, and it's such a noise, and it can be a bit annoying. Because what I believe is if you have a patient who you are looking after and he sees that you are going up and down, up and down the round and making patients feel better, then they will appreciate that at the end of the day, you have a patient who says, 'Oh, I don't know how you're doing it. You're running up and down all day long, and you do really do hard work.' It's just the fact that the patients appreciate the work that we do. At the end of the day, that's what we take with us at home.

## APPENDIX E: PHASE ONE EXTRACT FROM FRAMEWORK ANALYSIS

	A	B	C	D
1	Participant ID	Physical Environment	Tools and Technologies	(Nurse) Staffing
2	SU2INT	<p>"Co-location facilitates comms</p> <p>20,1 if there is something which I didn't understand from the handwriting or from the nurses' communication sheet, I can go to her personally and ask, 'Was there any problem? Do I have to do any particular task for this patient?' "</p> <p>"1,10: -nurse tells visitors of h1 that it is outside of visiting hours and as such they can only see patient one at a time</p> <p>2,16: more ppl arrive to see h1 - nurse tells them that she has told them several times already that they should only come one at a time</p> <p>4,11: nurse x goes to nurses desk and chats to the other nurse on the ward - they re annoyed that the visitors for h1 are still here "</p>	<p>11,9: Nurse makes notes on handover sheet to maintain situation awareness</p> <p>"And I personally... everyone does tend to make notes on their handover, and it's a very nurse thing, you'll put a little tick box there and then tick it when you've done it."</p> <p>12,9: Nurse tends to do the notes after she has done the main jobs in the morning</p> <p>"There does tend to be a routine. You do the drugs, you do the washes, you do the observations at ten o'clock. And then after that, I like to get all my jobs done before I've had my lunch, and then I can sit and write my notes after that.... So you sometimes will leave the notes until later on when you've done all of your rounds as it were. So that's kind of at the end of the day, basically... But I tend to do my drugs first, then my notes, because half of it, you're going to be writing, 'Patient needs this to be done'. [Laughter]"</p> <p>17,13: Nurse uses artefacts to keep track of exactly what she has done (place-keeping). If it hasn't been documented, it hasn't been done!</p> <p>"[Before attending to an unplanned task/ interruption] I always finish say that patient, but then I wouldn't continue with the medication round. I'd never stop in the middle of administering drugs, because that's when my - well, I think I'd be more likely to make an error. But I will then know, because obviously if I've picked up their chart and it's all signed, I know that I've given them that medication. "</p>	<p>6,28: workload and staffing affect care quality and safety</p> <p>"...we're always constantly without staff, which makes things harder because instead of me concentrating in a bay of six, I have to add two more patients.... I can't concentrate and give the attention of each patient as I would like to. Some of them they have major surgeries, most of them, and they can be fine now, and two minutes later they deteriorate quite easily."</p> <p>7,17: staffing affects care quality</p> <p>"When we are staffed, you know, I've got time for even a little chat with the patients, but when we're</p>
3	SU2OBS	<p>1,18: the drugs room is tiny and meds are arranged in trays a small cupboard (alphabetically). It is very time-consuming to find the drugs - and sometimes they are erroneously ordered by brand name</p>	<p>14,16: [is prioritisation based on nurses' assessment of patients - and the assessment that nurses receive during the handover?] "Definitely. So when you're assessing a patient you know how stable or not the patient is, and how you need to get certain priorities first.... you will know by the handover and by your own assessment.. you need to judge it yourself."</p> <p>20,13: Work that is not recorded has not been done! Artefacts are the definitive record of what has been done</p> <p>"If [an unplanned task] it's something that will take a lot of my time that means everything will be delayed, and that means that I will be staying here until nine o'clock writing my medical note... They have to be done because.... what's not reported hasn't been done"</p>	<p>3,42: nurse in charge comes to speak to nurse x re short staffing</p> <p>5,32: -nurse in charge comes to ask nurse x if he has access to the system that allows booking of bank nurses he says no</p>
4	SU3OBS CP04DI	<p>4,12: -nurse X goes over to h1 to check his 'c pack' machine (which I think gives pain relief?) as it keeps turning itself off</p>	<p>1,3: nurse x starts the day with the drugs round - checks drugs chart</p> <p>1,11: goes through drugs chart and checks with patient what she wants</p> <p>1,26: checks chart again and sees that the patient has not had all their meds</p> <p>1,32: fills in fluid balance chart</p> <p>1,49: finishes rectal drug admin - then documents this on drugs chart</p> <p>2,4: speaks to student nurse and tells them what to write on the drugs and obs charts</p> <p>2,37: gives meds to patient and then ticks boxes on the patient's drugs chart</p> <p>2,48: takes patients drugs chart and goes to get some more drugs</p> <p>1,12: does obs for h1</p> <p>1,15: hold patients notes and programs pump</p>	<p>10, 6 Pharmacy are often short staffed</p> <p>Also, for example, when the pharmacy are short of staff, they are very good at informing the ward manager, that we are short of staff</p> <p>10,9 Staffing on the ward is generally good... but the implications of being</p> <p>7,24: It's difficult to provide emotional care when the ward is</p>

Figure 8-1 Extract from phase one framework regarding the nature of nurses' work – and factors that shaped this

	A	B	C	D	E
1					
2	<b>Participant ID</b>	<b>Unplanned Tasks</b>	<b>Competing Demands</b>	<b>Deferral/ finishing (sub)tasks</b>	<b>Delegation</b>
3	SU1OBS	1,6: phone rings 1,29: someone asks if a patient is expected 2,45: phone rings while nurse is near 2,52: doc mentions that a patient allergy wasn't documented! 3,1: phone call interrupts nurse doing obs - nurse answers phone immediately	1,42: nurse is on the phone but she is waiting so answers colleagues question re where milk can be found	2,10: someone arrives on ward looking for nic but nurse continues and refuses to be interrupted 2,14: nurse is setting up to do an IV infusion. Is distracted by another patient - tells them to hold on for a moment. Nurse does not bow to social pressure 2,32: HDU calls and wants to speak to NIC - but she is busy aspirating - says that she will call back	1,46: room e patient - who has dementia - wanted a card to watch TV. Nurse asks housekeeper to get this sorted - she agrees 1,52: nurse asks housekeeper to get an extension lead for IV pump machine 2,22: an IT guy arrives on the ward to fit the new monitors which are designed to replace the status boards (see 1,14). He asks to speak to nic. NIC delegates this task to the housekeeper 2,34: asks housekeeper to get new colostomy bag for patient as
4	SU2OBS	12,20: Planning and sticking to routine allows time to perform any unplanned tasks that may arise: "I try and get the medication and the patient comfortable straightaway in the morning... [and] my medical notes... if I can manage to do that before lunch that means in the afternoon if anything comes up I don't have to be worried .." 19,31: unplanned tasks do happen in the afternoon "So, there's always something comes up on an afternoon" 20,11: Unplanned tasks have important consequences "[If an unplanned task] will take a lot of my time that means everything will be delayed, and that means that I will be staying here until nine o'clock writing my	7,1: As a result of high workload, nurses may not pick up on changes in important changes in patient's conditions "And that's when you hear, say, 'Oh the nurse never managed to trigger the deterioration.' But why, because she is dividing in so many other patients" 7,7: Nurse cannot do everything all at once "the initial deterioration... It was missed because you can't do everything at the same time"	12,23: nurse does like to finish a task to 'get it out of the way' "But it's something that is a one off thing, and as I said to you, I use my little bell saying, 'Until I complete that, and it's out of my way,' so I can go back to my routine, I'd rather finish that... if I hadn't got any more priority, I'd rather do that, and it's out of my way. Because we're human, we do forget them." 21,22: unplanned tasks - delegating to doctors "...if it's something that you're worried about you will have to leave what you were doing and go... you go and act on it. Even if it's a phone call to the doctors and say, 'I'm not happy with this, come up and see it'"	21,5: Delegation is important for managing the workload "We have healthcare assistant, which are great... So if you're good on delegating some tasks that you know that they're able to do, you need to delegate. Because it's impossible, it's impossible for you to complete everything on your own." 21,22: When you delegate a job, you don't have to delegate responsibility - you can supervise the task "When you're delegating you can tell them, can you give me feedback and let me know what's going on... you will know that that person will come back to you and tell you what's happening... if it's something that you're worried about you will have to... act on it." 24,25: Nurses can say no if asked to perform an additional task if it might compromise safety "But a lot of times.. if you say, 'Not now,' you don't have to say
	SU3OBS	1,19: nurse spills methadone and so must clean this up and fill in an incident report form 2,8: Porter stops nurse to ask who ordered a wheelchair 3,3: nurse asks JHO for script for diazepam- he obliges	2,6: tells student nurse what to write on drugs and obs chart - and simultaneously makes bed. MY NOTES: I haven't seen a lot of it but making a bed is the kind of task that is done using this mode?! 2,8: Porter stops nurse to ask who ordered a wheelchair - without stopping, nurse tells him to ask		2,8: Porter stops nurse to ask who ordered a wheelchair and nurse directs him to nurse in charge

Figure 8-2 Extract from phase one framework regarding the nature of nurse interruptions

## APPENDIX F: PHASE ONE ANALYSIS OF INDIVIDUAL STUDY SETTINGS

Table 8-3 summarises the main themes for each of the study settings, separately, while Table 8-4 compares the settings on each theme. (The latter should not be regarded as a ‘cross-case analysis’; it merely compares factual information obtained about the settings.) Full details of each theme (for each setting) are described in the subsequent sections. (Individual’s real names have been removed or disguised in the raw data to protect their identity.)

*Table 8-3 Key aspects of clinical context in study settings*

	<b>Accident &amp; Emergency</b>	<b>Surgical Ward</b>	<b>Chemotherapy Centre</b>
Overview	<ul style="list-style-type: none"> <li>*Provides emergency care to adults and children, including those with traumatic injuries</li> <li>*Open 24 hr, nurses work from 08.30-20.30 or 20.30-8.30</li> <li>*25 beds (4 resus, 16 majors, 5 minors)</li> <li>*Aim to admit and transfer or discharge patients in 4 hrs</li> <li>*Mix of genders</li> </ul>	<ul style="list-style-type: none"> <li>*Provides in-patient care for those undergoing upper and lower gastrointestinal (GI) surgery. Small number of urology (5% of cases)</li> <li>*21 beds plus 4-bed level 2 High Dependency Unit (HDU)</li> <li>*Nurses work from 07.30-19.30 or 19.30-07.30</li> <li>*Mix of genders but bays not mixed (except HDU)</li> </ul>	<ul style="list-style-type: none"> <li>*Provides short-duration chemotherapy treatment</li> <li>*Nurse-led out-patient service open 09.00-17.00</li> <li>*20 chairs split across four zones</li> <li>*Most patients on a 2-day pathway (they see the oncologist on day 1 and have chemotherapy on day 2)</li> <li>*Mix of genders</li> </ul>
Layout and Physical Environment	<ul style="list-style-type: none"> <li>*Four main areas: 1) a reception and waiting room, 2) a ‘minor treatments’ area, 3) a resuscitation room, 4) a ‘major treatments’ area</li> <li>*Majors the largest area, with 16 beds</li> </ul> <p>(Continued over the page)</p>	<ul style="list-style-type: none"> <li>*Comprises four single-patient rooms, two six-bed bays, one five-bed bay and four-bed HDU</li> <li>*Main thoroughfare is U-shaped with entrances/ exits at the ‘tips’ of the U</li> </ul>	<ul style="list-style-type: none"> <li>*Comprises a waiting room/ reception, a main treatment room, and five additional offices or consultation rooms</li> <li>*All chemotherapy treatments took place in main treatment room</li> </ul>



	<b>Accident &amp; Emergency</b>	<b>Surgical Ward</b>	<b>Chemotherapy Centre</b>
Nurses' Travel and Movements	<ul style="list-style-type: none"> <li>*Nurses' travel and movements varied according to the role allocated</li> <li>*Majors nurses spent considerable time walking around the ward looking for patients, other clinicians &amp; resources</li> <li>*Senior nursing roles involved less movement</li> </ul>	<ul style="list-style-type: none"> <li>*Nurses travelled extensively around their allocated area</li> <li>*Key facilities such as drug room are centrally-located, minimising travel. However, nurses had some long journeys (e.g. HDU to sluice).</li> <li>*HDU nurses did less walking</li> </ul>	<ul style="list-style-type: none"> <li>*Nurses spent the majority of their time in the treatment room, and could walk around quickly</li> <li>*However, they had a long walk if they needed to collect something from another department (e.g. nurses walked to the pharmacy or oncology clinic once or twice per shift)</li> </ul>
Key Nursing Tasks	<ul style="list-style-type: none"> <li>*Nursing tasks varied according to where individual was allocated to work. 'Core' tasks included: <ul style="list-style-type: none"> <li>-Triaging and assessing patients</li> <li>-Initiating investigations (e.g. blood tests, urine)</li> <li>-Delivering basic treatments</li> <li>-Recording observations (e.g. blood pressure, ECG)</li> <li>-Monitoring patients and keeping them updated</li> </ul> </li> <li>*High division of labour among nurses – lots of different nursing roles. However, nurses worked flexibly and role boundaries were blurred much of the time.</li> <li>*Heterogeneity of patients and different roles on the ward provided variety – but many tasks are routine</li> <li>*Low administrative burden – although nurses required to document patient information on computer system</li> </ul>	<ul style="list-style-type: none"> <li>*Nursing tasks varied according to the role the nurse was allocated. 'Core' nursing tasks' included: <ul style="list-style-type: none"> <li>-Assessing patients and coordinating treatments</li> <li>-Performing the medications round (three times)</li> <li>-Flushing patients' lines</li> <li>-Helping patients with hygiene needs</li> <li>-Conducting observations</li> </ul> </li> <li>*Moderate division of labour – most nurses do similar role</li> <li>*Diversity in types of surgery, and in patients' condition provided job variety. However, much work was routine</li> <li>*High administrative burden – full details of patients' conditions and observations recorded</li> <li>*Nurses spent a lot of time moving equipment and helping patients get in to/ out of bed</li> </ul>	<ul style="list-style-type: none"> <li>*Key nursing tasks included: <ul style="list-style-type: none"> <li>-Coordinating procurement of chemotherapy with other departments</li> <li>-Coordinating patient arrival and departure</li> <li>-Preparing chemotherapy and related drugs</li> <li>-Administering chemotherapy and related drugs</li> </ul> </li> <li>*Low division of labour among nurses – all nurses do essentially the same job. However, the ward is highly dependent on the oncology clinic and pharmacy, so division of labour is higher than it first appears</li> <li>*Heterogeneity of patients and different types of treatment provided variety – but many routine tasks</li> <li>*High administrative burden – comprehensive details about chemo treatments are documented</li> </ul>
Tools and Technologies	<ul style="list-style-type: none"> <li>*Two main computer systems (one for majors and one for minors) used to record and access key patient information. Systems highlight key information and helped clinicians to plan and coordinate care</li> <li>*Ambulance tracking system used to keep track of, and communicate with, ambulances</li> <li>*Paramedic handover sheet described the paramedics' assessment of the patient. Used by nurses to remember patient information</li> <li>*Ward status board used to represent where patients were located and who (which clinician) was responsible for their care</li> </ul>	<ul style="list-style-type: none"> <li>*The handover document contained details of patients' status, condition and treatments. Helped nurses keep track of patients and tasks, and to plan their work.</li> <li>*Patient notes contained detailed information regarding patients' medical history, procedures, and test results.</li> <li>*Nurses used notes to provide useful context and to support decision making</li> <li>*Drugs charts used to keep track of what drugs had been given to patients. Also meant that nurses did not have to remember drug information</li> <li>*Vital signs monitoring devices allowed nurses to get on with other tasks knowing they would be alerted if needed</li> </ul>	<ul style="list-style-type: none"> <li>*The scheduler document was shared among all parties responsible for chemotherapy. It included details of each patient, their treatments, test results, etc</li> <li>*The document supported planning and eased communication requirements.</li> <li>*Chemotherapy records contained detailed information about patients' conditions and treatments. Used by nurses to plan treatments, their comprehensiveness meant patients could be allocated to any nurses</li> <li>*Treatment protocols reduced memory demands</li> <li>*Drug infusion equipment allowed nurses to perform other tasks while chemotherapy was administered</li> </ul>
Staffing and Temporal Aspects	<ul style="list-style-type: none"> <li>*Most staff nurses band 6, although there were a number of band 5s</li> <li>*Charge-nurse usually a band 7. He/ she was supported in managing the department by another band 6 or 7</li> <li>*1 nurse allocated to minors, 1 to resus, and 4 to majors</li> <li>*Morning periods were generally quiet, while late afternoons and evenings were the busiest times</li> </ul>	<ul style="list-style-type: none"> <li>*Seven nurses scheduled to work day shift, six at night.</li> <li>*1 nurse allocated to bays A, B and G; 2 in HDU; and 1 or 2 in siderooms. 1 or 2 HCAs were scheduled to work on every shift</li> <li>*Most nurses band 5, although a small number of band 6</li> <li>*Short-staffing common during the observation period</li> <li>*Night shifts less busy than day shifts</li> </ul>	<ul style="list-style-type: none"> <li>*Two nurses allocated to each of the four zones in the treatment room (i.e. eight nurses in total), and one healthcare assistant.</li> <li>*Most nurses were band 6s but a small number band 5.</li> <li>*Considerable variation how busy the ward was</li> <li>*Reorganisation of oncology services resulted in an increased patient load</li> </ul>

	Accident & Emergency	Surgical Ward	Chemotherapy Centre
Communication	<ul style="list-style-type: none"> <li>*Nurses required to communicate extensively with patients, other health professionals and admin staff</li> <li>*Nurses mostly communicated with patients in-person, face-to-face. Usually at bedside or waiting room</li> <li>*Nurse-patient communications usually involved nurses checking patients were comfortable, assessing them, or updating them</li> <li>*Nurses did not always meet the demand for information</li> <li>*Nurses communicated almost constantly with other healthcare professionals – usually through chance encounters on the ward. Most such conversations involved updating one another regarding that status of a patient or task</li> <li>*Communications with healthcare professionals at other sites occurred via beepers and/or phone</li> </ul>	<ul style="list-style-type: none"> <li>*Since patients were often acutely unwell, nurses required to communicate in a timely manner</li> <li>*Frequent chance encounters among colleagues used to exchange information.</li> <li>*Stakeholders who spent less time on ward (e.g. surgeons) were often beeped or contacted by phone</li> <li>*Majority of communications concerned specific patients, or individual treatments</li> <li>*Communication most commonly face-to-face</li> <li>*Formal meetings also important. Shift handover and bed handover meetings took place at start and end of shift.</li> <li>*Monthly staff meeting concerned matters of policy</li> <li>*Majority of nurse-patient communications took place at bedside. They mostly concerned the patient's condition or treatment, but sometimes involved social conversation</li> </ul>	<ul style="list-style-type: none"> <li>*Nurses communicated extensively with stakeholders including patients, clinicians and support staff</li> <li>*Patient communication ensured that patients understood treatments, knew signs of toxicity, were kept updated regarding problems with treatment delivery etc</li> <li>*Communication demands were reduced by use of tools such as 'scheduler' document</li> <li>*However, nurses communicated a lot with colleagues on an ad hoc basis</li> <li>*Nurses often spoke to colleagues to check medications</li> <li>*They also spoke to the receptionist regarding patients' status and appointments</li> <li>*Communication among colleagues on the ward usually occurred face-to-face. Communication with oncology staff and pharmacists tended to occur by phone</li> </ul>
Teamwork	<ul style="list-style-type: none"> <li>*Nurses worked closely with a wide variety of colleagues, including staff nurses, doctors, physiotherapists etc</li> <li>*Some tasks, such as moving immobile patients, and treating trauma patients, <i>required</i> teamwork</li> <li>*Not all staff had opportunity to develop close relationships e.g. specialist doctors visited A&amp;E only rarely</li> <li>*Trauma teams often contained individuals who did not know each other</li> </ul>	<ul style="list-style-type: none"> <li>*Nurses often asked colleagues for help with specific tasks such as moving or lifting patients</li> <li>*Less experienced nurses asked questions of more senior colleagues frequently</li> <li>*Nurses often delegated low-skilled work, such as changing or making beds, to Healthcare Assistants</li> <li>*Nurses asked questions of doctors (surgeons) on their twice-daily rounds. Urgent issues also discussed ad-hoc</li> </ul>	<ul style="list-style-type: none"> <li>*Chemotherapy centre worked with oncology clinic and pharmacy to obtain information and treatments.</li> <li>*However, relatively little teamwork was required among nurses on the chemotherapy ward to deliver treatments.</li> <li>*Tasks that did require teamwork included checking drugs, and for one another during breaks</li> <li>*Nurses worked closely with the receptionist e.g. regarding arranging patients' appointments</li> </ul>

*Table 8-4 Comparison of study settings on key context factors*

*Overview	<p>*A&amp;E by far the largest capacity</p> <p>*A&amp;E and surgical ward open 24 hours, chemotherapy centre open 09.00-17.00</p> <p>*Chemotherapy centre patients and most surgical patients are planned admissions rather than emergency. Nevertheless, there remained considerable uncertainty in the Surgical, and to a lesser extent, in the chemotherapy wards, regarding the timing of patient's arrival on the ward</p> <p>*chemotherapy patients were generally less acute and more stable than surgical patients – especially HDU patients. While some A&amp;E patients were in a critical or unstable condition, the majority were not.</p>
Layout and Physical Environment	<p>*A&amp;E a rectangular 'racetrack' design; surgical ward uses a u-shaped design; chemotherapy centre square shaped (in the treatment room that is)</p> <p>*chemotherapy patients accommodated in reclining chairs, surgical ward and A&amp;E patients accommodated in beds. A&amp;E patients however who are waiting to be seen usually wait in chairs</p> <p>*chemotherapy centre located far away from other departments upon which it closely relied i.e. oncology clinic and pharmacy. A&amp;E and surgical wards were not so reliant on other departments, and they also had more visits from relevant staff (e.g. surgery consultants did twice daily rounds in the surgical ward; specialist clinicians helped to assess patients in A&amp;E). The physical environment might therefore have been less problematic for</p>
Nurses' Travel and Movements	<p>*A&amp;E nurses likely spent most time travelling and moving as A&amp;E is relatively large and nurses often went to other wards.</p> <p>*Day Chemotherapy nurses had a very long walk when they wanted to collect something from pharmacy or the oncology clinic – but they generally walked less often, and for shorter distance than Surgical or A&amp;E nurses</p> <p>*Surgical HDU nurses did not travel very far as they had their own supplies and equipment. Being present in HDU more or less all of the time allowed nurses to constantly monitor patients (which was considered an important part of HDU nurses' roles</p>
Tasks and Job Variety	<p>*chemotherapy nurses' work was much more specialised than that of Surgical or A&amp;E nurses. Chemotherapy nurses spent the vast majority of their time preparing or administering patients' drugs, monitoring infusions, or communicating with others regarding patient treatments. A&amp;E and Surgical nurses on the other hand spent much more time performing more general nursing tasks e.g. reassuring patients, taking vital signs observations, helping patients with hygiene, administering basic treatments</p> <p>*Division of labour varied between wards. It was high in A&amp;E, moderate in surgical ward and low in chemotherapy centre. The division of labour for the chemotherapy Centre was much higher if you include the pharmacy and oncology clinic – which were crucial to the centre's work</p> <p>*The administrative burden for nurses was quite high in the chemotherapy centre and surgical ward, but much lower in A&amp;E</p> <p>*All settings offered some degree of work variety, yet all had a number of routine tasks. Overall, there was less variety and more routine in the chemotherapy centre compared to the other settings</p>
Tools and Technologies	<p>*Nurses in all settings used a range of documents and artefacts to help plan and coordinate their work, and to remember key tasks.</p> <p>*Especially key documents and artefacts included the handover document and drugs charts in the surgical ward, the scheduler document and patient notes in the chemotherapy ward, and the main computer system in A&amp;E</p> <p>*A&amp;E and chemotherapy nurses made extensive use of computer systems, while Surgical nurses relied exclusively on hard copy documents</p> <p>*A&amp;E and the surgical ward included ward status boards allowing clinicians to quickly see where patients were and who was looking after them</p> <p>*Infusion pumps used extensively in chemotherapy and Surgical wards. Allowed nurses to continue with other activities while medication was being administered</p> <p>*Vital signs monitoring equipment used very frequently in the surgical ward and A&amp;E – but only rarely in the chemotherapy ward</p>
Staffing and Temporal Aspects	<p>*Surgical nurses was less experienced on average than those working in the other settings The majority of nurses on any given shift in A&amp;E, or in the chemotherapy centre, were band 6, whereas most in the surgical ward were band 5</p> <p>*Surgical ward had problems with recruiting staff and with managing sickness levels – the other settings did not</p> <p>*A&amp;E was often busier during the night shift, while the surgical ward was generally quieter. There were no night shifts in the chemotherapy centre</p>

Communication	<p>*Nurses in all three environments were required to communicate extensively with patients, other health professionals and support staff.</p> <p>*Nurses on the A&amp;E ward communicated with patients at the bedside or in the waiting room. Communications were usually to check the comfort of patients or to assess or update them. Patient communication in the Day Chemo Centre centered around treatment. On the Surgical ward, priority was given to timely communication due to the acute illness of the patients.</p> <p>*Nurses on all wards communicated frequently with other healthcare professionals – face to face and through the use of beepers or phone.</p> <p>* On all wards, email was used to communicate regarding policy and procedure matters.</p>
Teamwork	<p>*Nurses on the A&amp;E and Surgical wards often helped each other with tasks. Relatively little teamwork was required among nurses on the chemo ward.</p> <p>*Nurses on all wards worked closely with a wide variety of colleagues – doctors, surgeons, receptionists, pharmacists.</p> <p>*Relationships on the three wards varied because of the nature of the work. Not everyone was able to develop close working relationships with specialist doctors called to A&amp;E temporarily and trauma teams often contained individuals who didn't know each other; nurses in the Chemo Centre relied heavily on other departments to maintain patient care, nurses on the surgical ward were able to delegate lower skilled work to Healthcare Assistants while HDU nurses worked closely together in attending difficult cases.</p>

The sections below include references to raw data, and they employ the format described in Table 8-5.

*Table 8-5 Format of references to raw data*

DC1INT 1,8 = chemotherapy centre, participant 1, interview transcript page 1, line 8
SU3SHA 3,21 = surgical ward, participant 3, shadowing observation notes page 3, line 21
AE3FN 1 = accident & emergency, participant 3, observation fieldnotes page 1

## **Accident and Emergency**

### **Layout and Physical Environment**

The floorplans in Figure 4-1 (page 119) and Figure 4-2 (page 120) depict the main areas in the Accident and Emergency ward. Four main areas can be distinguished, as follows: 1) the waiting room and reception, 2) the ‘minor treatments’ area (known as ‘minors’), 3) the resuscitation room (all depicted in Figure 4-1), and 4) the ‘major treatments’ area (known as ‘majors’; depicted in Figure 4-2). Table 4-2 (page 119) describes the number of beds in each area, as well as the number of nurses typically allocated to work there.

The waiting room accommodates patients who present themselves at A&E (those brought in by ambulance are taken to majors). The reception contains various technologies used to register patients upon their arrival, and to communicate with other departments. Two triage rooms adjacent to the reception and waiting rooms (labelled “Triage 1 and Triage 2” on Figure 4-1), respectively, are used to triage non-ambulance patients. The minor treatments area contains a desk with two

computers, a supplies cupboard, and a drug vending machine. Two additional rooms in the minors area are used flexibly (labelled 43A and 43B on Figure 4-1). The resuscitation room contains a variety of equipment and supplies (e.g. defibrillators, vital signs monitoring machines) used to resuscitate patients and treat those with traumatic injuries.

The major treatments area (Figure 4-2) is the largest of the four areas described. The layout resembles a 'racetrack', with patient rooms on the periphery of the 'track', and storerooms in the centre. The small room labelled 'Staff Base 14' on Figure 4-2 is known as the 'charge-nurse area' (since he/ she is usually based there). It contains various communications technologies and a 'ward status board'. Much of the coordination between health professionals took place here during observations. The most acute patients were allocated to the rooms surrounding the charge-nurse area (exam 11 to exam 17 on Figure 4-2).

Opposite the charge-nurse area is the ambulance-triage desk (labelled "triage" on Figure 4-2). This is comprised of a desk (with computer), patient chair, and a vital signs monitoring machine. At busy times, a 'majors waiting area' was set up in Office 5. Other rooms frequently visited by majors nurses include the Clean Utility, Sluice, and Psychiatric Liason room.

There was limited visibility of patients in majors. One of the nurses expressed particular concern about visibility on the ward during interview.

*At [this hospital], you don't have complete vision of what it can... My other hospital, you sit in the middle of the department, you can see everyone around. It's safer like that. AE4INT 6,34*

*If you have the vision, you can see the department. [In A&E, where visibility of the ward is poor] Somebody can have a fit in any of the cubicles, and you can't really meet them with your eye. AE4INT 6,36*

### **Nurses' Travel and Movements**

Majors nurses spent considerable time walking around the 'racetrack' looking for individuals or resources. One common, and long, walk was from majors to the reception. Staff nurses often walked this route to use the scanner or discuss something with reception staff (AE3SHA 5,35; AE4SHA 1,25). The charge-nurse and the ambulance triage roles involved relatively little movement (e.g. AE3SHA 1,36).

As well as walking a lot, nurses frequently moved patients into, and out of, beds, and around the hospital.

### **Key Nursing Tasks**

Key nursing tasks included triaging and assessing patients, ensuring patients were comfortable, initiating investigations, delivering treatments, and recording observations. In addition, nurse managers shared responsibility for the management of the ward, and completed tasks such as managing bed availability,

organising patient transfers (to other wards or hospitals), and ensuring key targets (e.g. four hour wait time) were met.

The ambulance triage was performed by a dedicated nurse, stationed at the ambulance-triage desk (labelled 'triage' in Figure 4-2). It involved nurses listening to paramedics' assessments of patients (individuals that they had brought in), before conducting their own assessments. The nurse would then make a decision about where the patient should be taken (e.g. majors or minors; and a specific room), and log patient information on to the computer.

The non-ambulance triage involved many of the same steps/processes – although there was no paramedic handover.

The ambulance triage usually took place within a few minutes of patient arrival – although it sometimes took longer when the ward was busy. The non-ambulance triage took rather longer on average. Only on one occasion was the 15-minute target for the ambulance triage breached (AE3SHA, 2,15).

Common investigations initiated by nurses included blood tests (AE1SHA,2,25; AE3SHA,1,7; AE4,2,14), urine tests (AE5OU,4,22), and X-rays (AE0SHA,2,25). Treatments delivered by staff nurses included cleaning and dressing wounds, suturing, and administering painkillers/ selected other drugs.

There was a high division of labour among nurses, as evidenced by nurses performing quite different roles e.g. majors staff nurse, minors staff nurse, triage



nurse, charge nurse, float nurse etc. However, nurses worked flexibly and role boundaries were blurred when the department was busy, or when patient cases required collaboration.

The extent to which individuals performed the tasks described above depended on the role they were allocated. The variety of cases in A&E, and the fact that nurses were allocated different roles, afforded them considerable job variety.

*[The main tasks] It depends which part of the department I work. Every time, the task is different. As a general thing, of course you have to look after the patient, that's your job. But actually, it depends. Where I'm working every shift, the task is different...AE4INT 1,2*

Nevertheless, many aspects of their jobs, such as performing tests and providing basic treatments, were quite routine in nature (AE7INT, 4,25).

Nurses were responsible for updating the computer system when there was a change in patient status. Beside this however, nurses (or at least, staff nurses) had relatively little administration to do.

While complex and acute cases imposed considerable demands, only a small proportion of A&E cases were complex. Many cases were routine and there was a surprising 'regularity' (and thus predictability) in A&E patient cases.

## Tools, Technologies, and Supplies

Two main computer systems were used to record all details relevant to a patient's stay in A&E. One system was used for majors patients, and the other for minors patients – but the systems were otherwise very similar. The systems are not, therefore, distinguished in the sections below (the term 'computer system' is used to refer to both).

Table 8-6 describes the main patient information recorded by the computer system.

*Table 8-6 Key patient details stored on A&E computer system*

- |  |
|--|
| <ul style="list-style-type: none"><li>• patient's name, age, address, GP name and address etc</li><li>• time of patient arrival and method (i.e. ambulance or not)</li><li>• time of triage</li><li>• presenting condition(s) and relevant medical history</li><li>• time assessed by doctor, details of doctors' assessment</li><li>• details of any tests conducted – and results</li><li>• ward where patient will be sent and time bed request</li></ul> |
|--|

The 'home screen' provides an overview of the ward, displaying current patients in rows, and highlighting key information such as breaches or near-breaches. The nurse can click on a 'patient' to find any of his/her details.

The computer system could be accessed by all doctors and nurses, and it was used extensively by the latter (nurses). In particular the charge-nurse and the triage nurse(s) used the system frequently to coordinate care (e.g. AE5SHA 1,6; AE5SHA 2,35). The system reduced communication demands and perhaps, the

need for interruptions i.e. since staff could log in to find key information rather than disturb colleagues (AE5SHA 2,37).

Hard copies of patient information, printed out from the computer system, were stored in a filing cabinet in the charge-nurse area. Clinicians sometimes used these to make notes during patient assessments.

Several other computerised tools were used in addition to the main computer system – including the ambulance tracking system and the blood-test ordering tool. The ambulance tracking system was used by nurse-managers to keep track of, and communicate with, ambulances. The main screen, displayed on the ambulance-triage desk, showed any ambulances on their way to the hospital to the hospital, as well as basic information about the patients' condition. It also included a button which allowed nurses to communicate (to the ambulance service) that they had no capacity.

The blood-test ordering tool was used frequently by both doctors and nurses on the ward. A dedicated phlebotomist responded to the request and results would be added to the computer system.

Another important document was the paramedic handover sheet. This was completed by paramedics on their way to hospital and it described the paramedics' assessment of the patient, and any vital signs data recorded. Triage nurses often annotated this document (e.g. adding information about their own assessment) – especially when the ward was busy and nurses were unable to log

patient details on to the computer system right away (e.g. because another patient was waiting to be triaged; AE3SHA 3,46).

The ward status board in the charge nurse area ('Staff Base 14' on Figure 4-2) was used to represent where patients were located in the department, and to show which nurses were responsible for each one.

Other technologies that were widely used included devices for obtaining one-off readings of patients' vital signs (e.g. thermometer, blood sugar reader, pulse oximeter, ECG), and equipment to monitor such signs – and to alert nurses when any parameter(s) became dangerous – over extended periods.

Nurses dealt with a wide range of important medical supplies. Slings, bandages, plasters, dressings were important in minors particularly as well as painkillers, blood pressure meds etc.

### **Staffing and Temporal Aspects**

Most nurses worked from 08.30 to 20.30 (day shift) or from 20.30 to 08.30 (night shift) although staggered shift start times were introduced part way through the study.

The charge-nurse was usually a band 7, and he/ she was supported, at busier times of day, by another senior nurse (band 7 or 6) performing a 'float' role. 'Float' nurses were deployed flexibly, wherever they were most needed. The medical team usually comprised one or two emergency consultants (often including a

locum consultant) and his or her registrars. A locum GP was often working in minors along with nurse specialists.

The majority of staff nurses were band 6, although there were a number of band 5s. Nurses were allocated specific patients to look after: one nurse was allocated to minors, two to resuscitation, and four to majors.

Morning periods (e.g. 6am-11am) were generally quiet, while late afternoons and evenings were the busiest times (3pm-1am) (AE3SHA AE5SHA AE6SHA).

### **Communication**

Nurses were required to communicate extensively with a range of stakeholders, including patients, health professionals, and hospital administrators. Nurses communicated with patients frequently, mostly face-to-face. Such communication usually occurred at patients' bedsides, or in waiting rooms, and it concerned the patients' condition or treatment e.g. nurses checking that patients were comfortable (e.g. AE3SHA 4,37; AE4SHA 2,28; AE5SHA 4,3), questioning them for assessment purposes (e.g. AE4SHA 1,44; AE6SHA 2,8), or updating them about planned treatments.

Nurses kept patients informed about whether/ when they would be seen by a doctor (e.g. AE3SHA 4,2; AE3SHA 6,1; AE3SHA 2,30), have a test such as an X-ray (e.g. AE3SHA 6,18; AE5SHA 1,34), be given specific treatment(s) (e.g. AE3SHA 2,1; AE3SHA 2,3), be transferred to another ward (e.g. AE3SHA 5,31; AE5SHA 3,30), or be discharged (e.g. AE4SHA 2,3; AE1SHA 3,3).

Nurses also answered patient call bells (e.g. AE4SHA 2,26; AE4SHA 2,40), and provided advice about what patients should do after leaving hospital (e.g. how to take medications: AE5SHA 2,34).

Despite nurses' efforts, they did not always meet patient demands for information. Patients often asked when they would be seen (e.g. AE6SHA 4,14; AE3SHA 1,35), or when test results would be available (e.g. AE4SHA 3,37).

As well as communicating with patients, nurses also communicated with their relatives and friends. Relatives often called to enquire about a patient's condition (e.g. AE3SHA 5,24; AE1SHA 2,41), or asked when the patient was due to be seen (AE3SHA 6,34).

Nurses communicated with other clinicians almost constantly. Such communications occurred throughout the ward, and they usually involved face-to-face, chance encounters rather than organised meetings (e.g. AE1SHA 1,36; AE2SHA 5,11; AE3SHA 2,3; AE5SHA 2,7). Co-location therefore seemed important in facilitating communication (e.g. AE5SHA 2,7 fieldnotes). This regular,

informal communication helped ensure that key patient information was shared among the clinical team.

More formal communications included regular 'board round's where doctors would share what they knew about all patients in the department, and discuss treatment options. These occurred 3 times per day (8am, 12pm, 4pm) and took place in the charge nurse room. Meetings were led by a consultant and attended usually by the charge nurse

In the most acute situations, where a patient had sustained traumatic, life-threatening injuries, a 'trauma alert' was sounded over the tannoy system (e.g. AE3SHA 4,39; AE6SHA 1,35) to indicate that the trauma team (which might include all nurses on the ward) should prepare to deal with an imminent case.

Communications with healthcare professionals based at other sites/ wards occurred via beepers, which were carried by all clinicians, and/ or the telephone. The charge nurse seemed to be on the telephone almost constantly at times (e.g. AE1SHA 2,36).

Communications with hospital administration were mainly conducted via email and often concerned policies and procedures.

*"I think email, you just get inundated with stuff, and you just kind of filter through it... And the thing with checking emails is there's no time allocated for you to*

*check your email. So if it's very busy, you just don't have a chance to do it so you will miss out on stuff, but it's not your fault." AE5INT 14,33*

## **Teamwork**

Nurses worked closely with their nurse colleagues. They offered assistance to colleagues when they had free time (AE2SHA 1,29; AE2SHA 7,20; AE3SHA 1,10); and they covered each other's work when they went for breaks (e.g. AE1SHA 2,16; AE2SHA 1,41; AE5SHA 4,30). Nurses worked flexibly, especially when it was busy, and the boundaries between roles were blurred at these times (AE3SHA 1,25).

Nurses also worked closely with different types of doctor, physiotherapists, and psychiatrists to coordinate patient care. Multidisciplinary teamwork allowed the pooling of expertise from a range of professionals, improving the breadth of skill available.

*"for me, MDT works better... You have more or less every specialty, a nurse radiologist, everyone in one team.... I think the [importance of the] team is just massive." AE5INT 15,27*

*"My experience for this place now, this new place, it was quite nice, from my experience. So far, so good.... They do work quite nicely together as a team." AE4INT 10,26*

Another aspect of teamwork involved more experienced nurses providing guidance to less experienced individuals (e.g. AE4SHA 3,28; also see AE2SHA



2,7; AE4SHA 3,2). Informal 'mentoring' was also observed among senior nurses e.g. an experienced charge-nurse offered guidance on bed management to a less experienced colleague (e.g. AE2SHA 4,7).

Senior nurses delegated administrative and less-skilled jobs to more junior nurses (e.g. AE3SHA 1,40; AE3SHA 3,19), allowing them to focus on more demanding tasks.

## **Surgical Ward**

### **Layout and Physical Environment**

As the floor plan in Figure 4-3 (page 121) shows, the ward comprises four single rooms (siderooms C, D, E and F), two six-bed bays (bays A and B), one five-bed bay (G), and the four-bed HDU (bay H). Table 4-3 describes the number of beds in each area, as well as the number of nurses typically allocated to work there.

Bays A and B were used by males and G bay was used by females. The side rooms were mostly occupied by females, although priority was given to those carrying an infection (SU7INT1,12) due to the hospital's strict infection control protocols and isolation measures.

The main thoroughfare is u-shaped with the ward entrances/ exits located at the 'tips' of the U (the main entrance/ exit being the right-hand tip in Figure 4-3. The nurses' station is located at the bottom right corner of the 'u' and it contains three computers, while ward 'status' boards' are positioned on the adjacent walls.

Behind the nurses' station is the clean utility (labelled 'C.U.' in Figure 4-3, which contains the main medications cupboard. The HDU is located at the bottom left corner of the 'u', and it has its own medication/ supplies cupboard, a small area for drug preparation, and a desk with a computer. Adjacent to HDU are the staff room, the storage room (where the majority of supplies and equipment are kept), and the family room (where patients' relatives can sit).

Visibility was limited for nurses working on the main ward – especially those looking after patients in single rooms. HDU nurses however had excellent visibility.

### **Nurses' Travel and Movements**

Nurses travelled extensively around the areas to which they were allocated. Key facilities, such as the nurses' station and drug preparation room, were located in central areas, minimising the net travel distance. However, in some cases, nurses had quite long journeys e.g. HDU nurses had a long walk to the sluice (see Figure 4-3). Overall, HDU nurses moved less than those on the main ward, as the unit is more self-contained (e.g. it has its own medications cupboard).

## Key Nursing Tasks

Nursing tasks varied according to the role and grade of the nurse, and where on the ward individuals were allocated to work. However, all nurses performed a number of 'core' tasks including assessing patients, coordinating patient treatments, performing the medications round, flushing patients' lines, recording observations, helping patients with hygiene needs, and ensuring patient comfort (e.g. getting drinks, blankets etc). All of these activities also had to be documented of course.

Some nurses considered providing emotional support and care a key part of their role (SU4INT 4,2; SU4INT 3,12), while others considered it a 'desirable' aspect, that could be done if there was time.

*I find it very difficult when you're short-staffed, and you are just doing what needs*

*to be done for the patient because you haven't got time to do that little extra bit.*

*But that's just me. I like to try and do something a bit more for the patient.*

*SU4INT 7,24*

The medications round was performed at 8am, 12pm and 6pm. It was expected to last one hour but there was quite a lot of variation in how long it actually took (SU3SHA 4,11). Nurses working the night shift generally administered the morning IV medications (mostly antibiotics) at 6am.

Much of Surgical nurses' work was routine in nature. Drugs rounds, for instance, involved the same activities, more or less, each time – while HDU nurses' work

involved repeatedly recording observations, and ensuring patient comfort and hygiene (SU5SHA 2,25). On the other hand, it was claimed that HDU nurses were more likely to have to manage medical emergencies (e.g. SU3SHA 2,30; SU3SHA 4,34).

*The HDU is very structured, and even though it's a brilliant learning environment,*

*I just prefer the ward... there's maybe a lack of variety [in HDU]... SU4INT 2,25*

Nurses – especially those working on the main ward – spent a lot of time moving equipment and helping patients get into/ out of bed.

HDU patients were, by nature, unstable and HDU nurses had to monitor patients much more closely than their colleagues on other wards. Nurses had fewer pats in HDU than in the main surgical ward.

### **Tools, Technologies, and Supplies**

Tools and technologies used on the ward included the handover document, drugs charts, patient notes, the ward status board, infusion pumps, and vital signs monitoring devices.

The handover document was a spreadsheet print-out containing details of patients' status, condition and treatments. Nurses were given this document during the shift handover meeting, and a senior nurse (from the outgoing shift) read out key information from the document, and provided additional details e.g. regarding the context in which treatment decisions were made.

Some nurses carried the handover document around with them and continued to make notes on the sheet throughout their shift. Nurses expressed that this helped them keep track of patients and outstanding tasks (SU3SHA 4,37 and CP4INT 10,7). The document was thought to play a vital role in care coordination.

*And I personally... everyone does tend to make notes on their handover, and it's a very 'nurse' thing, you'll put a little tick box there and then tick it when you've done it. SU4INT 11,9*

Patient notes contained detailed information regarding patients' medical history, procedures, and test results. Hard copies of patient notes were kept in a trolley near the nurses' station – or next to patients' beds in HDU. Nurses sometimes used the notes when they wanted to know more about a patient's history or treatments, as this could help them (nurses) to decide how best to care for patients. Several examples were recorded of nurses checking the notes before administering medications to patients. This was explained in terms of the need to verify that patient prescriptions were in fact appropriate (SU3SHA 4,20; SU6SHA 5,46).

Nurses also said that they liked to use the notes to save their remembering information for long periods. In particular, nurses liked to document patient observations (vital signs readings) in the notes as soon as they had made them (SU4INT 16,6; also see SU3SHA 2,6; SU6SHA 6,31). The notes were also considered the ultimate record of clinical events.

*They [the medical notes] have to be done because.... what is not reported hasn't been done SU2INT 20,11*

Drugs charts were often carried around by nurses during medications rounds to help them keep track of what (drugs) they had given to patients. The charts also served as a prompt for medicines that required elaborate preparations (e.g. SU2SHA 2,48; SU5SHA 4,47). Nurses ticked off drugs as they administered them to patients (SU2SHA 1,49; SU2SHA 2,48).

*But I will then know, because obviously if I've picked up their chart and it's all signed, I know that I've given them that medication. SU4INT 17,13*

The ward status board allowed clinicians to quickly determine where patients were, and who was looking after them (including the nurse and the responsible consultant). The ward was often used by nurse managers when planning and managing bed availability (SU6SHA 5,31).

Commonly used technologies included infusion pumps and vital signs monitoring devices. The latter were considered helpful as they allowed nurses to get on with other tasks in the knowledge that they would know if there was a problem (DC4INT 3,10). Then again, nurses lamented the frequent false alarms caused by these (DC4INT 3,10).

## **Staffing and Temporal Aspects**

The ward is staffed 24 hours a day, with nurses' working from 07.30 to 19.30 (day shift) or 19.30 to 7.30 (night shift). Nurses have one hour for lunch and two 15 minute breaks.

Seven nurses were scheduled to work the day shift and six at night. Nurses were allocated specific patients to look after: one nurse was allocated to look after patients in bays A, B and G; two were allocated to HDU (bay 'H' in Figure 4-3); and one or two cared for those in siderooms C to F. One or two HCAs were also scheduled to work each shift.

Most nurses were band 5s, although there were a small number of 6s as well. Ward management tried to ensure that there was a good 'skill mix' at any time e.g. to there were experienced nurses around to supervise junior colleagues (SU7INT 3,17). Short-staffing was common during the observation period due to a combination of sickness-absence, and a difficulty in recruiting new nurses.

Night shifts were considered less busy than day shifts since patients were generally asleep.

## **Communication**

Nurses had to communicate with a range of clinicians and support staff, to organise a variety of patient treatments. Since patients were often acutely unwell, there was a need for nurses to communicate in a timely and accurate manner.



Most clinicians involved in Surgical patients' care spent time on the ward, facilitating chance encounters. These were often used by clinicians to update one another regarding key patients and tasks (e.g. SU4SHA 4,7 fieldnotes). Stakeholders who spent less time on the ward, notably consultant surgeons, were often 'bleeped' or contacted by telephone. However, nurses talked to the surgeons when they performed their twice-daily rounds.

The most common reasons for nurses' communications with other clinicians were to coordinate team activities (e.g. agreeing who is doing a particular task), and to exchange patient status information. Communications regarding policies and procedures (e.g. how a particular form should be filled in) and social communications were less common.

*So I find that they [HCAs] are great and if they find that they can see something not normal they will come and communicate with you, that you can act straightaway. SU2INT 21,10:*

All types of communication most commonly occurred face-to-face. Telephones and beepers were used by staff nurses primarily to coordinate patient collection with porters, and to discuss patient care with the medical team.

One frequent formal meeting was the shift handover meeting. This took place in the staff room at the start and end of nurses' shifts (07.30 and 19.30). During the handover, the outgoing nurses provided a summary (both written and verbal) of patient statuses, including details of their condition and any relevant care plans.

More details of the 'handover document' are included in the section on cognitive tools and artefacts.

*In the handover, you'll get an idea of who's sick, so to speak, and who needs the close monitoring, and who doesn't. SU4INT 10,7*

After the shift handover meeting the nurses also took part in a bedside handover (between 7.30-8.00) – where more detailed patient information could be discussed.

Another type of formal meeting was the monthly staff meeting, which concerned matters of policy and procedure mainly (e.g. SU4INT 10,17). It was noted however that such ward-level issues also tend to be communicated by email (CP4INT 11,4).

*"And most of it, like policy updates and things like that, tends to be by email."*

*CP4INT 11,13*

*"I think it [email communication] is good in a way, because a lot of people can't always make the ward meetings. I live an hour away, and if I've just finished a nightshift in the morning, I'm not going to come back in..." CP4INT 11,6*

The majority of nurse-patient communications took place at the bedside. Patients could either call nurses over (i.e. verbally), or they could use their call bell. When the call bell was used an alert was sounded throughout the ward. Call bells went

off a handful of times on each shift, but often, nurses did not respond immediately, preferring to finish the task they were doing, or asking an HCA to help.

Nurse-patient communications generally involved discussing the patient's condition or their treatment, or social communications. Regarding the latter, nurses varied in the frequency and extent to which they socialised with patients.

*Nine times out of ten, I start talking to the patient anyway, because that's just the sort of person I am. I will start talking to them as I'm giving them anything.*

*SU4INT 17,24*

## **Teamwork**

Nurses worked closely with other nurses on the ward. More experienced nurses shared knowledge and expertise with more junior colleagues, and helped with tasks like drug preparation (SU2SHA 1,17). They also supervised student nurses, who were thought to require a lot of support (SU7INT 2,25). The ward managers pointed out that nurses regarded as 'experienced' on the surgical ward may not be considered 'experienced' elsewhere.

The following quotation, from a newly-qualified nurse, demonstrates the support offered by experienced nurses.

*just because now I'm wearing blue doesn't mean I'm an expert... because I'm new the girls are quite good, I always say, 'What is this?' 'How do I do this?' How do I*

*go forward?’ And everybody normally has very good advice to give me. SU2INT*

*19,4*

Certain nursing tasks *required* teamworking (that is, they couldn’t be performed by a nurse alone). For example, moving some patients from beds and/ or chairs required teamwork, and nurses also had to ‘cover’ each other (to monitor each other’s patients) when they went on breaks. HDU nurses held a joint responsibility for all patients on the unit, and they worked closely together, communicating any changes in patient status or care plan.

As well as nurses, the team also comprised HCAs, a dietician, a physiotherapist, and different types of doctor (mainly the surgeons, their registrars, and house doctors). For the most part, health professionals were thought to work well together.

*I think in general we work quite well as a team. (SU4INT 8,26)*

*it’s good because they [the doctors] do come around [on twice-daily rounds]*

*and... if we have any problems we can grab them. Otherwise, the bleep is just*

*two seconds away and they will pop in to and give us a hand with what we*

*need.... (SU2INT 16,19).*

Multidisciplinary teamwork ensured a greater breadth of expertise was available. Good examples of multidisciplinary teamwork concerned patient discharge

decisions e.g. the charge nurse discussed who to discharge with doctors (SU01SHA 1,12), and got input from specialist nurses to support this decision (SU01SHA 2,42).

The ability to delegate tasks was thought by nurses to be an important way for them to stay on top of their workloads.

*We have healthcare assistant, which are great... you need to delegate. Because it's impossible, it's impossible for you to complete everything on your own.*

*(SU2INT 21,5)*

Nurses tended to delegate low-skilled tasks such as changing bedsheets, and taking patients for a walk, to HCAs (and sometimes to student nurses). This allowed them to utilise more advanced skills. Nurses also delegated many unplanned tasks, helping them to avoid interruptions, and any adverse effects that these might have e.g. on nurses' productivity or patient safety (SU7INT 4,24). Indeed, a ward manager mentioned that he/she considered 'protecting' nurses from interruptions – particularly during medication rounds – to be a key part of the HCA role (SU7INT 4,24).

While nurses thought it was important to delegate, they also emphasised that they have an obligation to maintain awareness of the patient's condition.

*It's all very well delegating that task, but you need to make sure that they're within normal range, and you know what the patients' observations are... at the end of the day, it will come down to you. (SU4INT 4,11)*

Nurses thought it was important to help colleagues where possible, as they may need help themselves at some point – and need to demonstrate reciprocity.

*you should work as a team. I think you need to have a good attitude; that is a core part of nursing. Because there'll be times when you're running around exhausted and you just need some help, and if you don't help people, they're not going to help you. (SU4INT 9,23)*

## **Chemotherapy Centre**

### **Layout and Physical Environment**

The floorplan in Figure 4-4 (page 122) shows that the Chemotherapy Day Centre comprises a waiting room/ reception, a main treatment room, and five additional offices. Table 4-4 describes the number of beds in each area, as well as the number of nurses typically allocated to work there. The main treatment room is a rectangular-shaped area, divided into four zones (A, B, C and D), with 4-5 chairs in each. Each chair is fully adjustable and has an oxygen supply, and emergency equipment next to it.

Other facilities in the treatment room include patient toilets, a Clean Utility, Dirty Utility, and two desks (labelled 'Staff Base 1 and 2' on Figure 4-4). The Clean Utility contains a locked fridge where chemotherapy, and selected other drugs, are kept. It also contains a variety of other drug administration equipment (e.g. IV giving sets) and supplies (e.g. dressings), as well as a fax machine and telephone. The Dirty Utility contains specialist disposal bins, and various other supplies. The two desks contain communications technologies and various (blank) forms.

The additional offices included the ward manager's office (labelled 'Quiet Room' on Figure 4-4), two flexible offices, used either for initial patient meetings (at the start of their chemotherapy course), or as an 'overspill treatment room'; e.g. DC21SHA 1,17). There is also a staff room.

## **Nurses' Travel and Movements**

Nurses spent the vast majority of their time in the treatment room. The room was small and nurses could access the resources that they needed quite quickly. However, the chemotherapy centre was quite dependent upon two other departments within the hospital – the oncology ward and the pharmacy – and these were a long way away. Nurses therefore had to walk a considerable distance if/when they needed to collect anything from, or have a face-to-face conversation with, an individual from another department. During the observation period, a HCA was assigned the role of collecting patients' drugs, medical records, and other resources that had to be picked up, so that nurses could get on with their jobs as much as possible. Nurses walked to the pharmacy or oncology clinic once or twice per shift.

## **Key Nursing Tasks**

The work process described above with regards the two day care pathway often 'broke down' at one or more stages e.g. the processing of blood tests, the writing/sending of prescriptions (from the doctors to the pharmacy), the delivery of medical records (from the doctors to the day centre), and the dispensing of drugs (from the pharmacy to the day centre).

To prevent breakdowns such as these, nurses checked up on the status of patients' assessments (as performed by the oncology clinic on 'day one') and patients' treatments (prepared by the pharmacy on day two) in advance of



patients' arrival on the ward. They did this by checking various information sources (described later), or by speaking to staff in the oncology clinic or pharmacy over the telephone. When nurses were busy however, they did not always have time to pre-empt potential problems. Moreover, treatments were often delivered late, even when nurses had attempted to avert problems.

Nurses had a large administrative load, with numerous documents to complete for each patient. They had to make records regarding the patient's condition (e.g. blood-test results), the drugs that they were administering, particular checks they had performed (e.g. to ensure that drugs were appropriate) etc.

In some respects, chemotherapy nurses' work was quite standardised and routine. Most patient treatments are delivered intravenously and they involve more or less the same processes (e.g. establish access, set up the infusion pump etc). However, patients have different treatments and the details of the administration (e.g. the type of dilutant required, the duration of the infusion) varied quite a lot. Differences in individual patient characteristics (e.g. personality, attitude towards treatment, stage of treatment) also provided nurses with significant job variety (DC2SHA 2, 16; DC5SHA 8,8; DC2INT 21,6).

Nurses had relatively little lifting or carrying to do and they rarely left the chemotherapy centre.

## Tools, Technologies, and Supplies

The most frequently used tools and technologies included the ‘scheduler’ document, patients’ chemotherapy records, and drug treatment protocols, and drug infusion equipment.

The scheduler document, a spreadsheet that was accessed in both hard- and soft-copy, was used frequently by nurses to plan their work (e.g. DC2SHA 1,22; DC2SHA 2,12; DC3SHA 1,6; DC3SHA 2,4). It was produced by the chemotherapy ward manager, in advance of the shift, and it was shared among all the parties responsible for chemotherapy treatment (i.e. nurses in the chemotherapy centre, staff in the oncology clinic and pharmacists in the aseptic unit). Details of each patient, the treatment they were due to have, and the time they were scheduled to have it were listed, while other information included whether the patient had seen the doctor, whether they had had blood tests, and whether their medicines had been prepared. Having all of this information in one place allowed chemotherapy nurses to see, at a glance, the status of a patient and/ or their treatment – and hence it enabled them to pre-empt any process ‘breakdowns’ that might occur (as described above). The document also prevented unnecessary communications regarding patients’ progress (i.e. since nurses could check the document rather than call the responsible department).

*We have our list of patients – you’ve seen it – in the early morning, you have to plan that.” DC2INT 16,14*

*“...I always look at the rota, ‘When is my next patient due in? What extra do I*

*have to prepare? What care does he need? Are there any special needs?’*

*DC4INT 11,12*

The scheduler was colour coded to highlight potential problems in obtaining a patient's test results or chemotherapy treatments.

*Red, it means there is a problem with the script, they haven't got a confirmation.*

*So we need to chase what the problem is – the bloods, or dose reduction, or the patient maybe didn't turn up to Clinic 8, so we have to chase that. DC4INT 1,12*

Patients' chemotherapy records were maintained by nurses on the ward and they contained detailed information about patients' conditions and treatments (e.g. DC3SHA 1,4; DC3SHA 2,1). The records, which were kept in hard-copy only, were used by nurses to plan patient treatments, and record key information. The comprehensiveness of chemotherapy records meant that patients could be allocated to any of the nurses on the ward, providing additional flexibility for management.

*Everything gets documented here, and, for example, if the patient is supposed to have an injection, or if the patient has to have a district nurse referral for pump disconnection, it's also in the notes documented. DC4INT 5,6*

*And also, very rarely, a patient is treated only by a named nurse... everybody will look after the same patient at one time... And it's very important to keep nursing*

*documentation for if anything went wrong.. Because [something went wrong]*

*two or three times in a row... then we need to sort it out. DC4INT 4,13*

When observations commenced, nurses' records were stored separately from those kept by the oncology clinic. However, certain patient data, such as blood test results, were only available on the company intranet (although once accessed, nurses would usually print a copy for the patient's record). Towards the end of the observation period, doctors' and nurses' notes were stored together (away from the ward) in line with trust policy. This created an additional demand to transport the records to/ from the ward in a timely manner.

Treatment guidelines and protocols could be found on the trust intranet, and they reduced the requirement for nurses to memorise information (DC5SHA 3,35).

Drug infusion equipment facilitated automatic intravenous infusions, using sophisticated infusion pumps. These allowed nurses to get on with other work while chemotherapy drugs were being delivered.

### **Staffing and Temporal Aspects**

The ward is open to patients from 09.00-17.00, but it is staffed from 08.30 -17.30. This allowed nurses to prepare for their patients, and to perform administrative duties.

There were generally two nurses allocated to each of the four zones in the treatment room (i.e. eight nurses in total), and one healthcare assistant to help

them. In addition, an experienced receptionist and the ward manager were on duty most of the time. Most nurses were band 6s but a small number were band 5s. Nurses were allocated specific patients to look after.

Considerable variation was observed in nurses' how busy the ward was (DC3SHA 2,5).

*...every day is different. And every day, it differs. Some days I'm more busy than others. I've noticed that on a Wednesday and Thursday, they are the busiest days, when we have five to six patients, each nurse. (DC4INT 2,30)*

During the latter stages of the study, a reorganisation of the hospital-trust oncology services (e.g. closure of the day chemotherapy unit at one of the other hospitals in the trust) resulted in an increased patient load (e.g. DC21SHA 1,13).

*Every day now is a busy day, not like before. We could say Monday, Friday, and we could identify [these as relatively quiet days]... it's more pressure now...  
DC2INT 14,15*

## **Communication**

Nurses communicated extensively with patients, other clinicians and support staff to coordinate care. Patient communications involved ensuring that patients understood exactly what is involved in their treatment (e.g. DC4; 1,38; DC5SHA 1,13), verifying patient identity (e.g. DC5SHA 2,10), checking for changes in patient condition which might effect treatments (e.g. DC5SHA 2,10), ensuring that

patients are aware of the signs/ symptoms of chemotherapy toxicity (e.g. DC5SHA 2,33). Other patient communications related to the provision of additional help and support e.g. transport, wound care, psychological support (e.g. DC5SHA 2,43). Patients were also kept updated about any problems in the delivery of their treatments (e.g. DC5SHA 1,27).

*Because by communicating with a patient, and making them aware that we are doing our best, they are more understanding. DC4INT 25,24*

The need to communicate with other clinicians was reduced by the use of tools such as the 'scheduler' document, medical records, and the trust intranet. In addition, colocation enabled nurses to ask their colleagues for help with any issues that needed clarification.

*if there is something which I didn't understand from the handwriting... I can go to her personally and ask, 'Was there any problem? DC4INT 20,1*

Despite these arrangements, nurses did communicate a lot with colleagues on an ad hoc basis.<sup>63</sup> Communications with immediate colleagues (other nurses in the centre) tended to involve checking medications (e.g. DC5SHA 2,10), physical tasks (e.g. DC2SHA 1,27; DC5SHA 3,37; DC5SHA 5,34), or questions regarding drug protocols (DC5SHA 1,37).

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<sup>63</sup> External communications regarding the procurement of chemotherapy drugs – and all the information required to achieve this – were described in the 'key nursing tasks' section.

Nurses also spoke to the following individuals; the receptionist regarding the status of patients (e.g. whether they had arrived on the ward), and arranging future appointments (e.g. DC2SHA 1,45); the HCA regarding the status of treatments (e.g. asking whether a particular drug had arrived DC2; 1,10); the ward manager regarding any particularly difficult problems that had arisen (e.g. DC5SHA 5,2)

Communication with colleagues on the ward usually occurred face to face, while communication with staff from the oncology clinic, and those from the pharmacy, tended to occur by telephone. Issues relating to policy and procedures tended to be communicated by email (e.g. DC2INT 13,6), or discussed in a monthly team meeting (DC2INT 12,15).

Chemotherapy nurses had to communicate with colleagues in the oncology unit, and the pharmacy, to get the information and the drugs they needed to provide patient treatments (DC2INT 7,12; DC2INT 12,1).

## **Teamwork**

As noted above, nurses worked closely with a few individuals in the oncology clinic and the pharmacy departments to ensure that the necessary information and treatments were provided. Chemotherapy nurses' work however required relatively little teamwork between nurses on the ward. Particular tasks that did require teamwork included checking other nurses' drugs (e.g. DC5SHA 2,10), physical tasks, such as lifting patients (e.g. DC2SHA 1,27; DC5SHA 3,37; DC5SHA 5,34), and answering colleagues' questions regarding treatment

protocols (DC5SHA 1,37). Nurses worked more closely with the receptionist (e.g. regarding arranging patients' appointments) and ward management (e.g. to resolve difficult problems) than with other staff nurses in many cases.

Nurses were observed delegating on several occasions (e.g. a nurse agreed to delegate a cannulation task to a colleague: DC5SHA 6,26). Also, the following quotation from a senior nurse demonstrates a willingness to delegate. Patients could be transferred from one nurse to another when one nurse was busy.

*Simple answer [to deal with people who present unplanned tasks to senior nurses] point them to the right person that they have to contact. That's the thing, if you are managing you should know.. DC2INT 20,9*

For the most part, nurses seemed happy to help each other, as well as colleagues in other departments. They reported frustration at other individuals not doing the jobs they were supposed to (e.g. the frequent failure of doctors in the oncology clinic to write and/ or send prescriptions).

*I think we've got a good team here, from [the ward management]... to the healthcare assistants. If there is anything we try to settle it as soon as we can, without making it a big issue. DC2INT 12,1*

*They are supposed to do it [write prescriptions] in the clinic not us chasing it up... some doctors when you do that they will become dependent on you... they will say they are busy, but we are busy too... DC2INT 7,12*



## APPENDIX G: PHASE TWO EXAMPLE OF DETAILED HIERARCHICAL TASK ANALYSIS

Figure 8-3 and Figure 8-4 illustrate the more detailed HTAs that were simplified after the pilot study identified the need for this.

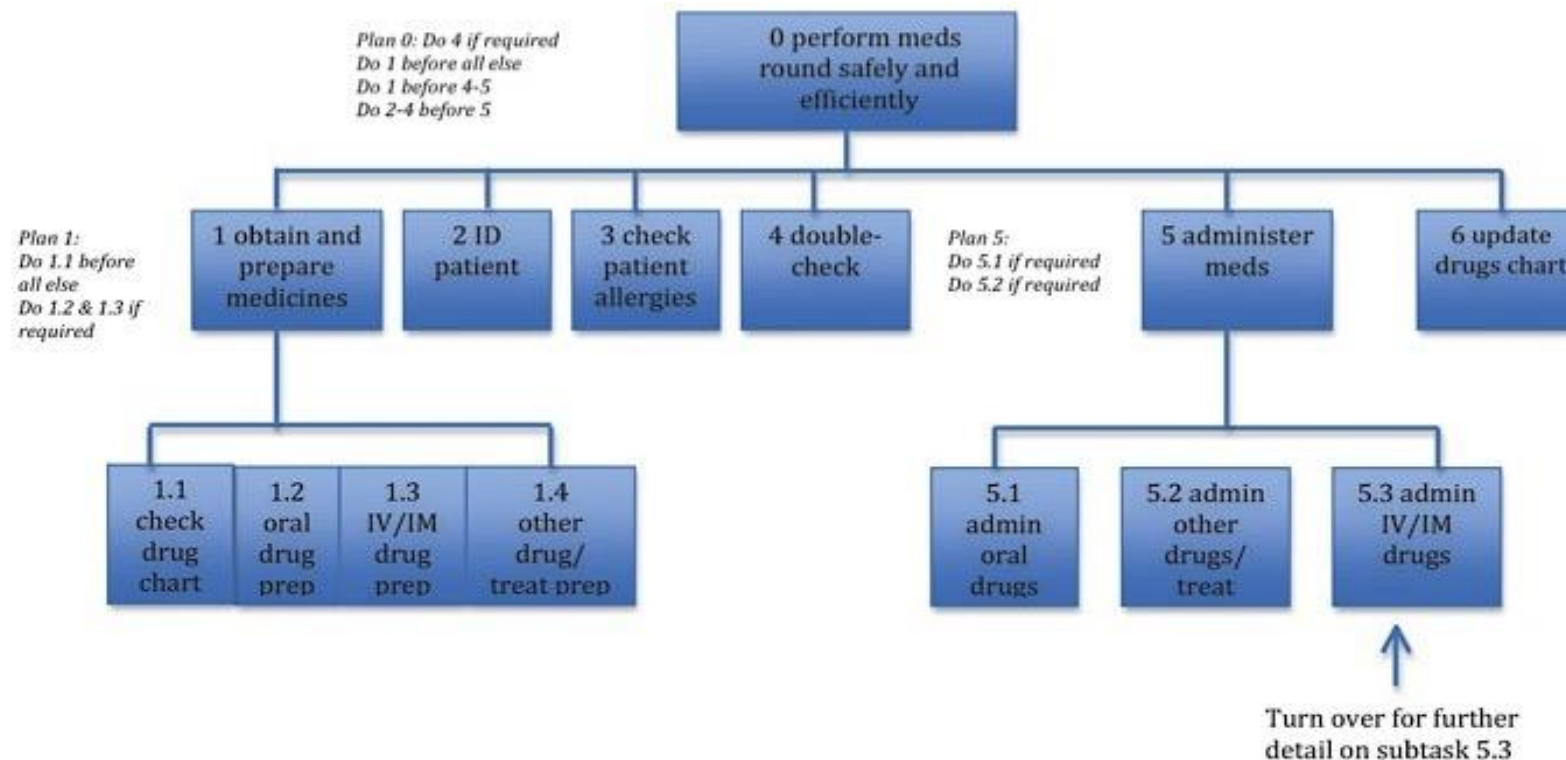


Figure 8-3 Detailed Hierarchical Task Analysis conducted in Surgical Ward (Part 1)

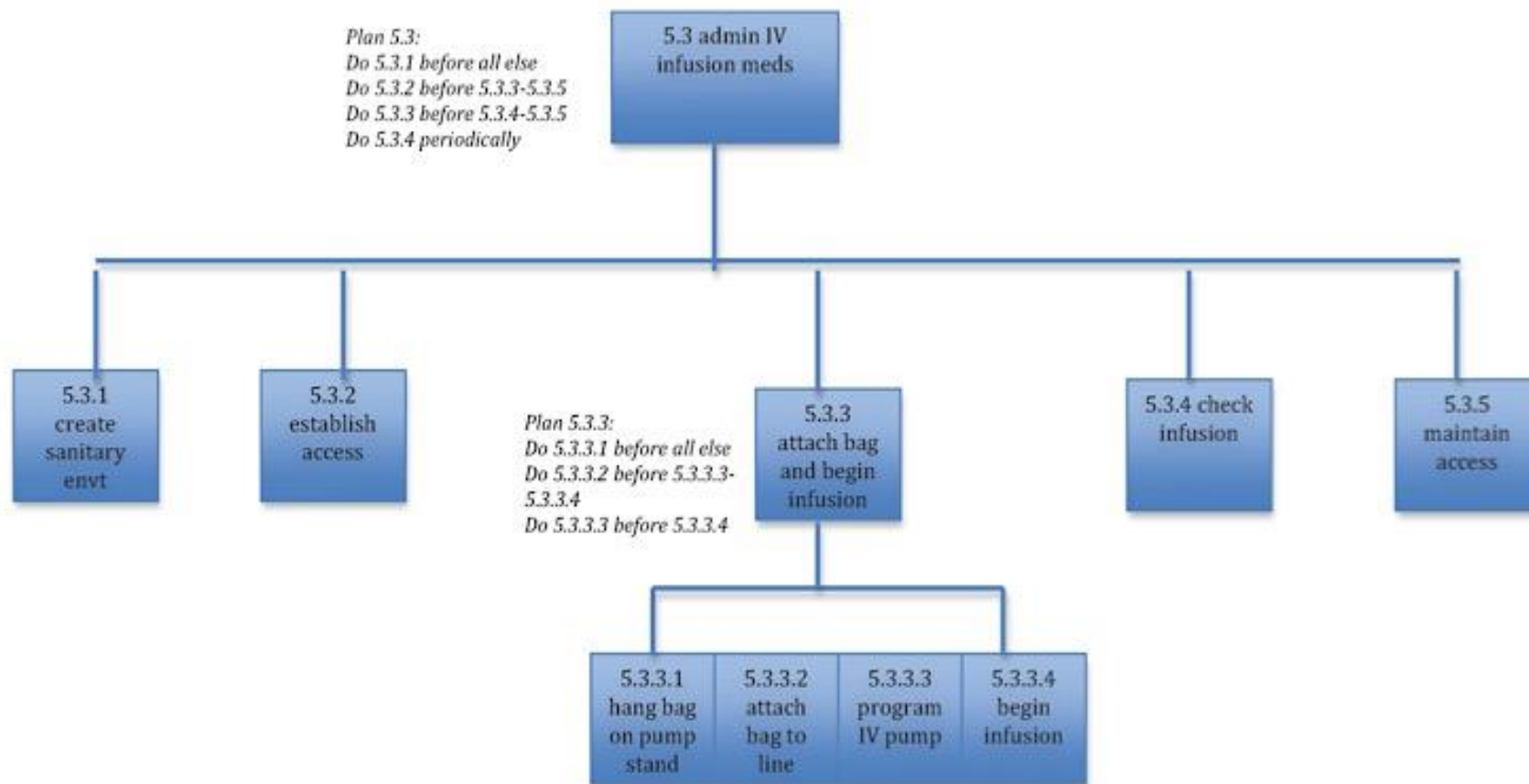
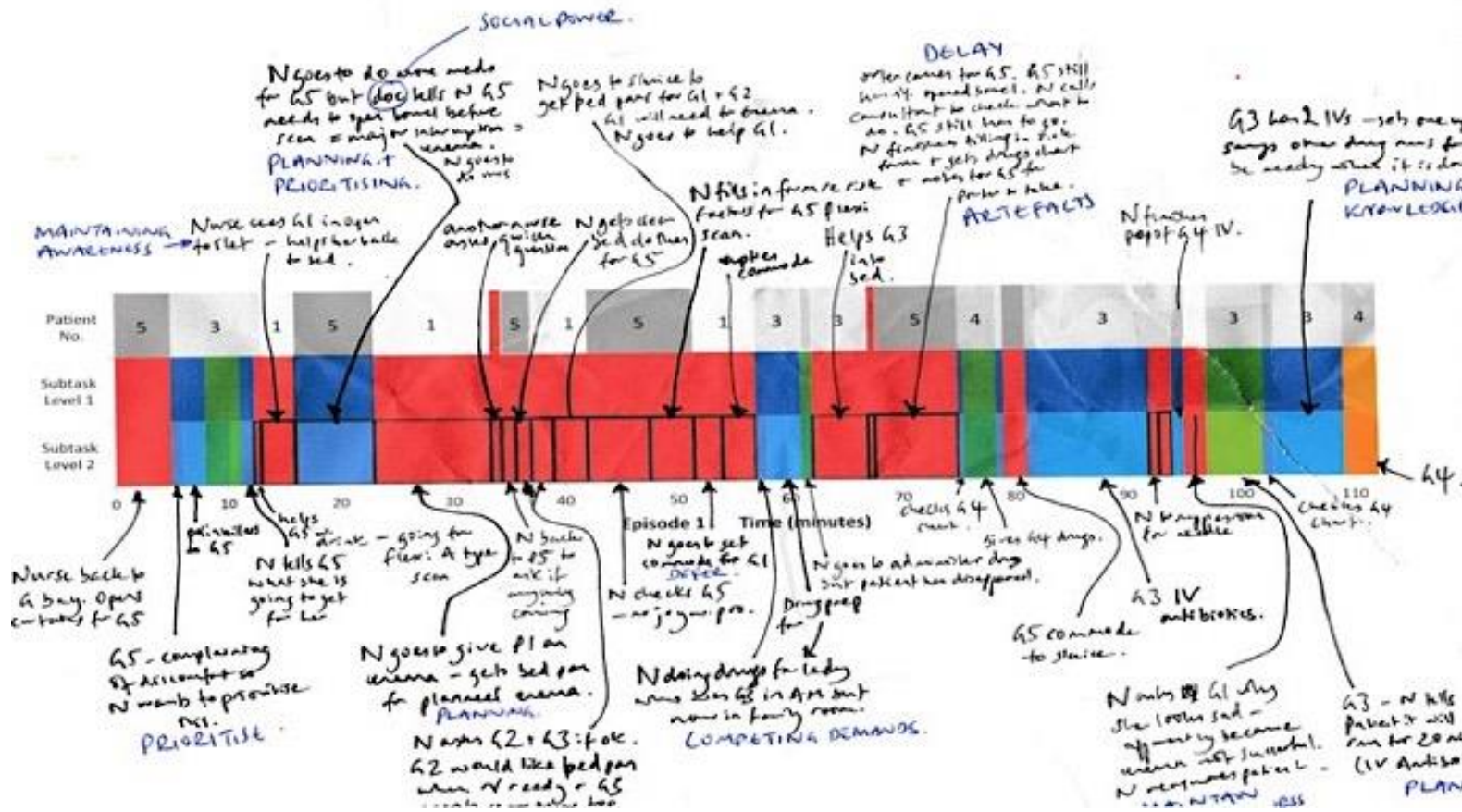


Figure 8-4 Detailed Hierarchical Task Analysis conducted in Surgical Ward (Part 2)

## APPENDIX H: PHASE TWO EXAMPLE DRAFT HIERARCHICAL TASK TIMELINE



The three coloured (or greyed-out) rows in the diagram correspond to the three levels of the HTA diagram presented in section 6.2.4.1. The top row refers to Patient Level of the HTA – hence the numbers represent different patients. The middle and bottom rows relate to subtasks level 1 and 2 respectively, and the (non red) colours represent HTA subtasks. Red blocks represent non HTA tasks, while the black, vertical lines dividing the blocks on subtask level 2, indicate that the same subtask was performed consecutively, for different patients.

Figure 8-5 Example draft Hierarchical Task Timeline (HTT) diagram

## APPENDIX I: PHASE TWO EXAMPLE PROSE DESCRIPTION

The following is an example of a prose description developed to accompany a Hierarchical Task Timeline (produced as part of the Timeline Analysis of specific episodes of competing demands described in Phase Two – see section 6.2.4.4, page 253). It relates to the Accident and Emergency ambulance triage task. The bold headings refer to new patients arriving for triage.

### **18.33 Patient 1 Man crashed bike into car door. Back pain**

The patient was wearing a helmet at the time but reported considerable back pain. The paramedics had therefore placed him on a back support stretcher. They had also given him paracetamol.

### *18.34 Performs P1 handover and asks doctor if patient should be immobilised*

The nurse began the paramedic handover and started to assess the patient. She recorded the patient's vital signs (blood pressure; oxygen saturation; pulse) using various machines (*tools*) and asked him about the nature of his pain (*situation assessment*). The nurse then asked one of the doctors whether she should immobilise the patient (*teamwork; coordination*) – but he felt this was unnecessary.

### *18.36 Conducts full examination of P1 & uses computer system to check available rooms*

The nurse conducted a full examination of the patient and asked him about his accident (*situation assessment*). She then checked the available rooms using the computer system (*tools; planning*) (many of the rooms were occupied at that point), before asking the paramedics to move the patient to a specified room (*teamwork*). *Prioritising* was evident since only the more acute patients, or those whose dignity is a particular concern, could be given a room when the ward was as busy (as it was at that time).

#### 18.38 Nurse defers new triage briefly

Another patient arrived and waited with the ambulance crew for triage. The nurse noticed her and said she would be two minutes (*active management of interruptions and managing attention*).

#### 18.38 Patient 2 Old lady, dementia. Vomiting and panicking

The patient was very old (95 years) and had dementia. Her main symptoms were being sick and panicking. She was also very frail.

#### 18.39 Nurse assesses P2 and reassures her

The nurse checked the patient's vital signs and performed the paramedic handover. She also had a short conversation with the patient's carers about her general health, and current symptoms (*situation assessment; planning*).

#### 18.43 Nurse defers new triage

The nurse mentioned that she had noticed a patient (P3) waiting in the 'triage queue' (while she was in the middle of assessing P2), who looked unwell. However, the nurse deferred the triage briefly (*active management of interruptions*)

*And then after her, then I could see behind her was another lady... P2, L62*

*She looked like somebody who could quite easily get sick quickly P4,L158*

The nurse's comments suggest that she had already engaged in some form of *situation assessment* – albeit quite limited – and *anticipating*.

#### 18.44 Checks free rooms in person. P2 moved to monitored room

Nurses sometimes preferred to check available rooms in person as the computer system did not always reflect the current situation. The nurse said during interview that she wanted the patient to go into one of the monitored rooms because she was frail and the nurse was concerned about the care that she was receiving at home (*planning*).

*And then I was also quite concerned about [P2... She was] more confused than the last time I'd seen her... she didn't look that unwell with it but just I was more concerned with her social standing. [I wanted her] being monitored is P4,L175*

#### **18.45 Patient 3 Old lady, chest pain, cardiac history.**

Lady was in her 90s and was complaining of chest pain and breathlessness. She had a long history of cardiac problems.

#### *18.46 Conducts handover, records observations, then moves P3 to room N*

The nurse performed the paramedic handover and recorded the patient's vital signs. She was particularly concerned to assess the patient's pulse and oxygen saturation – and she asked a series of questions relating to the patient's chest pain and cardiac history (*situation assessment; problem detection*). The nurse was clearly concerned about the patient and appeared to be *anticipating* potential problems.

*[the reason why the nurse was so concerned about P3 was] mainly on her observations but also, although she looked quite well, on any kind of exertion she then became quite breathless....P7, L315*

Further evidence of this anticipation can be seen in the following quotation. This also provides an example of the use *mental simulation*.

*...although her observations were abnormal, she's probably, she actually looked quite well with it but she looked like somebody who could quite easily get sick quickly... all you would have to do to knock her off is just a little bit of excess fluid and she could end up with pulmonary oedema because her heart's not actually functioning very well. P4,L160*

#### *18.49 New patient arrives but nurse defers*

The nurse defers a new triage in order to finish writing something about previous patient before triaging. Her decision suggests she felt it was important to finish her current task (*active management of interruptions; managing attention*) – perhaps because she was concerned she might forget key information. Certainly, the following quote supports this notion.

*OK, so when the ambulance has come in, I'll note down numbers which I won't necessarily remember, so their cad number, the time that they came in and their vital signs. And unless there's something significant... you're not going to remember those numbers. P2, L91*

#### **18.50 Patient 4 Lady with ankle pain**

Canadian lady in her forties complaining of significant pain in her leg and ankle. Paramedics suspected it might be broken but were unsure.

#### *18.51 Thorough handover and examination of P4*

The nurse performed a thorough paramedic handover and a detailed examination of the patient (*situation assessment*). In addition, she tested the range of movement in the patient's leg/ ankle, and the location of her pain (*problem detection*).

*If that [the patient's leg] was broken and in any way open they would have stayed in here but the skin wasn't open and the tendons were intact... P12,L579*

#### *18.53 Nurse asks colleague to check P3 & P4. She points to cardiac vital signs to communicate urgency*

The nurse asked one of her colleagues to check on the cardiac and dementia patients as a matter of urgency (*teamwork; coordination; prioritising*). The nurse had clearly continued to *plan* and *anticipate* problems that could occur with these patients. Another interesting aspect of this event, which is evident in the first quotation, was that the triage nurse felt able to simply point to P3's observations to convey her concern about the patient (and the need for action) to her colleague. This suggests the nurses had developed a shared understanding of what constitutes a 'critical' patient (*mental models; common ground*).

*...I know she understands when I just point at her heart rate and her stats.... I know that she's going to... put on her ECG and that she's going to carry on and inform the doctors P5,L207*

*It was quite reassuring that I know – certain people I know, most people actually in the department, I know that you can point out certain things that say actually she's quite unwell. P5,L223*

#### 18.54 Overhears colleague mention need to see P3 to doctor

The nurse indicated during the interview that she had overheard her colleague speaking to one of the doctors regarding the need to see the cardiac patient (P3) urgently.

*I'd heard [Nurse name] discussing this lady with the cardiac failure as well. I'd heard her say 'right, obviously she's elderly, I've done her ECG, her GP's seen her'. I'd heard those sort of things going on when she was talking to George, the registrar in charge. So yeah, it does make you... that will calm you as well and you think OK, that's done and you can kind of tick that off... P11,L536*

The quotation suggests that the nurse was actively listening to maintain 'situation awareness' (situation assessment). Also, the nurse's apparent relief that the task had been delegated indicates that she continued to feel some responsibility for coordinating care – even after she had requested help (teamwork).

Further evidence of this active listening was obtained from the nurse during the interview.

*But I've always kind of got an ear out.... But because I was eavesdropping I'd heard [a nurse] say earlier 'right, I'm going to take you to the ward now', to somebody. P11,L524*

#### 18.56 Discusses with charge nurse whether P4 should go to majors or minors.

While the nurse had conducted a thorough assessment of P4's ankle/leg [see 18.51], as the quotation below shows she felt it necessary to get a second opinion from the charge nurse. In particular, she wanted the charge nurse's view regarding whether the patient had broken his leg/ ankle, and whether he should be treated in the majors or minors area (situation assessment; problem detection; prioritizing; teamwork; coordination).

*I asked his [the charge nurse] opinion for the patient as well because sometimes that can be a bit of a grey area, you know, whether they are suitable for minor's*



*or major's, depending on how badly we think they may have broken their leg.... I felt happy that it was probably minor's but I wanted a second opinion P12,L570*

*18.57 Moved p4 without checking computer system*

The nurse asked the paramedics to move the patient to room K without checking the computer system This shows *situation awareness (also teamwork)*.

## APPENDIX J: PHASE TWO ANALYSIS – EXTRACT FROM PHASE TWO FRAMEWORK

A		B	C	D
1	Participant ID	Maintain awareness of patients and tasks	Plan & anticipate needs	Prioritise tasks and manage time
2	SU1INT	<p>Include commn, chance encounters, checking and monitoring, Patient assessment! <b>Maps to sitn assess MC function</b></p> <p>to maintain awareness so you can respond quickly to any toilet-related TCTs. This helps to avoid 'accident' and save time as Oh yes it was [a long task]. Giving the enema itself that's 2 seconds, that's not a problem. The patients have to wait 10 to 20 minutes [for the enema to have an effect], in the meantime it's going to cop an accident, that's because she's going to have an accident [a toilet-related accident]. And then she have to sit on the commode and then you will have to deal with that dirty bed, dirty linen, incontinence pads... 5,249</p>	<p><b>Maps to (re)planning &amp; adaptation, sitn assess and problem detect funcs. Also links to problem detection, mental simn, &amp; attn manage processes</b></p> <p>Now, saying that, if I'm by myself like I were today, it's one task I will not delay a second because it's not worth it, toileting. The risks are tremendous. People will move from the bed themselves, they will proper fall, you will have to go toilet, you will probably damage. Not worth it. If someone asks for the commode you should go and get it quite soon 1,42</p> <p>G5 was prescribed the enema – I knew from the early morning.... And I thought I do that one... one was prescribed, that was planned. G5 was planned. It needed to be done at twelve o'clock so she was able to go to her flexi (scan). TIME CONTINGENCIES So I thought I do that one first, get it out of the way, attend to the commode, blah blah blah, and then I do my round.</p>	<p>MAYBE MANAGE TIME SHOULD BE SEPARATE?!</p> <p>Specific tasks that are prioritised/ considered impmt. Time man goals</p> <p>Now, saying that, if I'm by myself like I were today, it's one task I will not delay a second because it's not worth it, toileting. The risks are tremendous. People will move from the bed themselves, they will proper fall, you will have to go toilet, you will probably damage. Not worth it. If someone asks for the commode you should go and get it quite soon 1,42</p>
3	SU2INT	<p>Nurse plans the meds round so she knows about any meds that take time to prepare. She would prioritise tasks that take longer. Use charts to support making. Anticipate potential fainting</p> <p>Well I guess it just delayed it but with her, well I was going to be dealing with her next anyway so there was no point me getting her medication ready to come back and she's still dizzy and then get the medication down, then get her into bed, because [the healthcare assistant], was already doing her bed and I looked at her and she was absolutely fine. I just did, you know, a quick assessment - she's not going to collapse. I thought let's just make the bed and then get her in quickly in case she did actually faint because then that would delay it by a lot. 4,198</p>	<p>making. Anticipate potential fainting</p> <p>Well I guess it just delayed it but with her, well I was going to be dealing with her next anyway so there was no point me getting her medication ready to come back and she's still dizzy and then get the medication down, then get her into bed, because [the healthcare assistant], was already doing her bed and I looked at her and she was absolutely fine. I just did, you know, a quick assessment - she's not going to collapse. I thought let's just make the bed and then get her in quickly in case she did actually faint because then that would delay it by a lot. 4,198</p>	<p>Need to manage time contingencies requires Mtasking. Diff medical teams/consultants create competing demands. Nurse does what she is told even though she doesn't agreed re need to do G1 immediately</p> <p>In theory, you plan ahead and you do this task after the round. But then someone come and say 'no you can't wait until you finish the round and do it. Teamwork and prioritising. Limited time windows require multitasking. Also helpful for nurse to ask doctor questions (can avoid delays this way)</p> <p>The routine's idealistic. Normally in the morning we hear about - because also the doctors come at any point and then you have to drop it and go on the ward round. And that can be in the medication round as well, but they need a nurse with them, they don't like to go on their ow... So the doctors are major a priority because they're around for a limited time... They decide what needs doing for the day, if it's a big clinical task, and if something's not prescribed I need to pounce on them then so that will interfere throughout the morning depending on their round. But then also you can have a discharge, you have to do a social service referral, transport may need to be booked. There'll always be something that gets in the way of my morning routine, but yeah 7,306</p>
4	SU3INT	<p>Visibility of the nurse may be both a benefit and a disbenefit! Patients may be considerate of what others are doing well, it works two ways. When they see how busy I am, some are oblivious</p>	<p>Nurse avoids making time commitments to patients. Sets time goals. Manage uncertainty and TCTs</p> <p>You can't [promise patients when you will do a job for them]. Something Prioritised patient in pain. Also this was more efficient since might otherwise have to involve the anaethetidst (anticipating!). Also nurse avoided undue multitasking; she thought she might as well get everything done for E immediately</p> <p>But I knew that [the patient in room] F were antibiotics and if she never interrupted me, I would go in this order. Now what made me stop here, I give</p>	<p>Prioritised patient in pain. Also this was more efficient since might otherwise have to involve the anaethetidst (anticipating!). Also nurse avoided undue multitasking; she thought she might as well get everything done for E immediately</p> <p>But I knew that [the patient in room] F were antibiotics and if she never interrupted me, I would go in this order. Now what made me stop here, I give</p>

Figure 8-6 Extract from phase two framework

## APPENDIX K: PHASE TWO EXAMPLES OF RAW DATA

Short extracts are presented below of Phase Two observation and post observation interview data. (Individual's real names have been removed or disguised in the raw data to protect their identity.)

### Observation Data (Accident and Emergency, session 8)

Observation data were recorded using the iLogger application described in the Phase Two method section. Figure 8-7 shows some examples of this data.



Figure 8-7 iLogger application example screenshots

### Post-Observation Interview Data (Accident and Emergency, session 8)

I Can you think of a time that was sort of where you felt like you had to manage quite a lot of competing events and demands

Erm, so there was a period when I took over in the afternoon where we had several ambulances arriving at the same time, plus the need for several shifting rounds of patients, movements of patients.

I Was that before I got here or after?

No, that was after.

I OK, OK.

So we arrived at about the same time this afternoon.

I OK, cool.

It was one of those funny days where had we been fully staffed, it would have been a dream, it would have been an absolute dream and in fact actually most of the day has been fine but you get these periods where you have an influx of [ambulances - 0:00:45] people or you're being asked to transfer patients because we don't have enough staff to kind of cover those bits.

I Sure.

And you come back and there's a queue of admin. So I remember coming back from my break actually and there was an ambulance had been waiting for 10 minutes which just makes you feel 'ohh'. However, that patient was fine, you know, had it been something where this patient looks really acutely unwell –

I Was that the lady with TB?

Yeah, yeah. Then I suspect someone would have stepped in before that.

I Sure.

So everyone's making assessments as and when they go, particularly if you notice a patient at the ambulance station and you think yes, they need to be looked at fairly quickly.

I Sure. Can I take you as much as possible back to the sort of context.

Sorry, yeah.

I So often what I do is have nurses draw a little time line but actually maybe it's not necessary. There was that lady and then what were the other –

My mind's gone completely blank. So we had that lady, then we had a couple of patients that needed referring to specialities.

I That's right.

So we had one lady that came in that had been discharged from an orthopaedic ward yesterday and then another that was a psychiatric patient. Neither of whom were acutely unwell but both we wanted to sort of get sorted fairly quickly because they're not people that necessarily need to be sitting around in A&E for too long. So with that, because I'm still fairly new to this, it's finding out how you go about making those referrals, then triaging them appropriately. So I did both of those and was quite pleased with how they went. It's quite nice when you've got the time

to make the phone calls and to get people sorted, especially with psychiatric patients. You feel a bit rubbish sometimes just dumping them in a room and then sort of saying 'someone will be along with you soon'.

I Of course.

So those were quite tricky because the referrals came in quite quickly. Then there was a period with the gentleman who was escorted in with the police.

I Sure.

So I think we had a couple of ambulances arrive at the same time. One massive benefit is that we've got someone from reception sitting there and getting them onto the system straight away.

I Sure, sure.

What can be really stressful in that situation is where you have patients come in, you sort of do the initial triage and then it takes them 20 minutes before they're on the system.

I Are you talking specifically about sort of patients, like psych patients or patients who need to be seen urgently?

All patients because actually, I mean today this hasn't been a problem at all, but one of the really stressful things about that is that then you've got the notes to be triaged and you need to do computer triaging and you can't because they're not on the system yet. So you've got this mounting pile of paper with a mounting number of ambulances coming in.

I Sure.

And in the meantime you sometimes then have to kind of go and sort out patients like that gentleman. I just asked one of the A&E reg's to see him straight away so we could get him sent onto an appropriate place and keep him sectioned under 136.

I Sure, sure.

This isn't a place of safety for that but they didn't feel they were able to take him anywhere until he had been cleared by an A&E doctor.

I Sure. So how did you – just sort of going back as much as we can to that situation, as you said but just to sort of recap, there was the lady with the TB and then there were the two referrals that you had taken over from NURSE X.

Yeah.

I So how did you – obviously you were sort of juggling balls there – how did you manage that?

So I think in A&E it's always a case of looking at the most acute situation first. Had any of those patients been acutely unwell, I'd deal with them immediately. So there was one chap, I don't know if you remember, who'd come in with a chest pain and who'd had a previous MI and I sort of stopped what I was doing. Luckily there weren't any other ambulances but even if there had been, I would have gone to do the ECG first.

I Sure. And where did he come in in the order?

Oh my God, I can't remember! [laughing]

I OK.

Honestly, it just kind of becomes a bit of a blur I think with all the patients coming in. So the decision making is a case of looking at the acutely ill patients.

I Sure. If you can try to sort of think back on the context as much as possible.

OK.

I How did you, if you can think back to when you had those two referrals and that chap, how did you sort of prioritise that? What did you think, you know –

So the things that can be done immediately that will make a difference in the long term. So, for example, the referrals, you went to get them done straight away because then it's almost like you've absolved yourself of responsibility for that patient, which sounds like a really unfair thing to say.